**Exploring Electronics** echnology For The Hobbyist And Professiona

October 1999 Vol. 20 No. 10 En Comment (And Other

- AUDIO DESIGN WITH OP-AMPS
- ATMOSPHERICS ENHANCE
- VHF/UHF/SHF RADIO RANGE
- POWERPOINTING YOUR PROJECTS — PART 2
- SERVOS, STEPPERS, AND OPTICAL **ENCODERS — PART 3**

And more ...



Coming Next Month ...



RADIO CONTROL SERVOS -

A PRIMER!

## MONSTER 47GB SCSI DRIVE



## \$695 FREE SCSI ENCLOSURE 408 330-5523

Open Windows instantly. Process huge graphic and database files with ease. Make your file server scream with speed.

The 47GB Seagate Elite is the drive you need for serious performance. It features 14 disks and 28 heads for blazing performance 3.5" drives can't touch. The Ultra Wide interface makes installation a snap. A 4MB cache buffer accelerates data transfers.

A special volume purchase brings you brand new drives at low, low PC prices. Shop around. Compare price. No one else can match this deal.

Buy just one drive and build the ultimate workstation. Or add several to take advantage of NT RAID performance. Let us custom-build your multi-drive disk array at no extra charge. Redundant rackmount trays stack to build arrays bigger than 1,000GB per rack!

Get the speed you need and the reliability you deserve. Get rock solid Seagate quality backed by a warranty of up to six years! Call now! Try your 47GB monster drive risk-free.



#### CORPORATE SYSTEMS CENTER

3310 WOODWARD AVE., SANTA CLARA, CA 95054 WWW.SCSIDRIVES.COM

Seagate ST446452W drives are PC, Mac, SGI, and Sun compatible. 5 1/4" Elite drives are sold only in OEM enclosures and disk array trays. CSC carries low-cost, top-quality PCI controllers and SCSI accessories. If you haven't already upgraded to SCSI, call us for help. No-risk guarantee refunds your entire purchase price (less shipping) if you're not completely satisfied within 15 days. Call for your free catalog of hard drives, duplication equipment, and accessories.



Serving Silicon Valley since 1964!

...brings you a potpourri of high-tech goodies for the techno-tinkerer! For thirty years we have been your source for Silicon Valley exotica!

#### Attention Hams! HSC has QRP!

Announcing the newest development in the hottest field of interest in ham radio...QRP! Low power rigs are the latest rage, and we now have the giant-killer entry on the market.

#### The *MN9* 9-Band QRP Transceiver Kit!

by Sierra Radio Enterprises

Available EXCLUSIVELY at HSC Electronics!

For the Ham Radio buff who likes to build his own rig, we offer this technically advanced transceiver that is fun to build and a dream to operate. Containing many features found only in upper-end transceivers, this is not an entry-level kit, although you will need no exotic test equipment to align and test. This will provide several evenings of enjoyable kit-building, and many more operating at the low-power end of the spectrum! Note: you should be fairly confident in your kit-building abilities before attempting this!

- ♦ 50 mW to 12 Watts CW / SSB
- ♦ USB,LSB, CWHI, CWLO (selectable CW sideband)
- 160 meters thru 10 meters, including WARC Bands
- Digital Frequency / Clock Display
- ♦ Vackar VFO with ZERO DRIFT! \*
- ♦ Built-in Electronic Keyer -- Built-in SWR Bridge
- ♦ Front-firing speaker, handsome front panel
- ♦ Full QSK CW Break-in, two jacks for paddle & key
- Narrow-band CW filter option
- ♦ Dual, Half-Lattice 9 MHz Xtal filter for SSB
- ♦ Variable RIT/XIT, Selectable IF Scan with Scan Adjust for filter rejection of unwanted signals.
- NO RELAYS!
- ♦ No external test equipment needed for alignment!

Tuning Versatility!...Adjustable bandspread, both in width and in Ham-Band Position! Once a given bandspread is chosen...set the limits and USE!

by adjusting two rear-panel mounted pots

Single, complete PC connection

For single non-bootable SCSI2 peripheral

New OFM pack with install diskette & manual

HSC#80503

#### PCI-Bus 56K Modem!

- Genica PCI-Bus 56K Modern at unheard-of price! Data, FAX, voice, full V.90 compatibility
- Voice from handset
- ♦ Windows 95/98 or NT only (Not Win 3.1 compatible)
- Uses latest Lucent chipset, comes with Lucent drivers New retail box, with expanded application software on CD.
- ♦ 90-Day Warranty

HSC#17532

\$19.95

\$17.50

Special!



\$39.95

\$469.00

#### Sidewinder Slashed!

ISA to SCSI Adapter

Adaptech model AVA-1505AI -- Brand Name Quality!

- Microsoft "Sidewinder" game controller ... Wowl New OEM package, high quality for fast action!
- Download drivers from Microsoft.com
- Eight programmable action buttons, two fire buttons



\$17.50

#### ATX-Style Mid-Tower!

- Need a case for your motherboard? · ATX-style mid-tower cabinet
- ATX power supply included
- Three 5.25° and two 3.5° front bays
- 16.5" H x 8.25" W x 16.5" D Brand new in box, 90-day war
- HSC# 80459



\$47.50

#### Topside Oil Extractor!





ASSEMBLIES

- SAVE MONEY! Quit crawling under your car!
- For autos, yachts, forklifts, tractors, textile machines, lawn mowers...any large or small engine!
- Pumps 4 liters in 3 minutes
- Model R602A . 12VDC powered!
- Air compressor option NOT included or available Many uses...wherever you need a small, portable pump!
- New...includes manual, hoses and molded carrying case

HSC# 17999

\$19.95

#### Price Breakthrough on Variable Transformers!

You say you've wanted one of these in the past, but the price kept you away? Now you can afford a brand-new variable AC supply for your workbench! All have enclosed cases, knob and dial.

- ◆ Model AlCVR-500W 120 VAC input
- ♦ 0 120 VAC ouput, 500 watts
- ♦ Measures 5" dia 6" tall
- · Features meter, binding post terminals for input, output
- New in box, made in China



\$50.00

- ♦ Model AEEC-1090VR, 120 VAC 60 Hz input
- ♦ 0 120 VAC output, 1 KVA
- Measures 6.5" dia., 8" tall

HSC#80474

- · Features meter, illuminated switch, line cord, fuse



HSC#80481

- Model AEEC-2090VR, 120 VAC 60 Hz input
- ♦ 0 120 VAC output, 2 KVA
- ♦ Measures 8" x 10" x 8" tall
- Features meter, illuminated switch, line cord, fuse
- New in box, made in China



Amazing power in a small package! Nickel-Metal Hydride (Ni-MH) batteries have the capacity of Nicads without the

ory\* effect. These are factory-new, not pulls!

♦ Toshiba 8TH-F5-F1-AIR, 9.6VDC at 600 mAH, mea

Or you can choose a NiCad battery pack in a similar form-factor. These are a flat array of cells, like the battery above, with handy solder tabs for connection. Thin NiCad pack, 8.4VDC at 450 mAH, measures 4.5 x

1.875 x .25" thick (7 cells in series)

Now, lower price!

Now, lower price!

Or you may need the power of a lead-acid battery. These

are all new batteries with tab terminals. Perfect for hobbies.

ecurity systems, battery back-up, garden equipment, etc.

♦ TR1.2-12, 12VDC at 1.2 AH, measures 3.75 x 1.875 x 2

♦ BAT-0063 (x2), 12VDC at 10AH, 4" x 6" x 4", this is two

6-volt batteries packaged in series by Best Powe

♦ TR4-6, 6VDC at 4 AH, measures 2.75 x 1.75 x 4

sures 4.5" x 1.875" x .25" thick (8 cells in series) ♦ Appears to have a thermal fuse for over-current p

HSC#80461

HSC#17871

HSC#17872

HSC#17197

HSC#17588

HSC#17810

\$125.00

\$7.50

\$4.95

\$4.95

\$17.50

\$85.00

#### Mini-Workstation Marvel!

- NEC Mini 486 workstation
- Great for network applications
- Model FE-1350-24401M has 486 DX2-66 CPU
- ♦ 8MB DRAM, (2 DIMM sockets, one open)
- ♦ VGA, SIO, PIO, PS/2 Keyboard ports, 2 ISA slots 210 MB IDE hard drive, 1.44MB floppy drive
- Measures 10.5" x 13" x 3.5""
- ♦ Unused, checked & refurbed, 90-day warranty



\$39.95

#### Hard Drive Blowout!

- Maxtor IDE hard drives, Refurbished Drive Special
- 3.5" form-factor, 1" high standard footprint drive
- Tested, 90-day warranty

400 MByte HSC#80492 HSC#80493 650 MByte HSC#80494 850 MByte

\$19.00 \$29.00 \$39.00

#### Power Supply

- ♦ 'LITEON' 145W fan-cooled supply
- Perfect for bench use or motherboard test/development!
- Note: this is not standard tower-case form-factor.
- ♦ Input: 100-127VAC ~ 5A/200-240V ~ 2.5A, 50-60Hz
- Output: +5VDC/18.5A, -5VDC/0.3A, +5Vs/0.02A, +12VDC/4A, -12VDC/0.3A, +3.3VDC/7A
- Standard ATX-motherboard, disk drive power connectors
- Measures 2.75" x 4.125" x 6"
- New, 90-day warranty



HSC#17973

#### Rechargeable Battery Buy! Video-hack is back! Three types of rechargeable battery for a variety of uses! Logitech Videoman Video-conference camera & interface These units were sold with Hewlett Packard S-700 work-

- stations for videoconference capability
- We have collected some data, check on our website at http://www.halled.com/online/index.htm All we have is cameras with stand, and SCSI-II interface
- The camera is on a weighted stand that extends from 13°
- tall to over 20" tall, and has a electret microphone

  Color camera is digital output, but some delicate SMT surgery will provide NTSC signals (not for amateurs!)

  Interface box has two SCSI-II ports on back, and a DC power input (we do not have the adapter), and on the front t has a mic. out jack, composite video input (BNC), and the connector for the camera cable.



HSC#17503 Now - Lower Price! \$29.95

#### Laptop Carrying Cases

- ♦ Measures 12.5" x 10" x 2" inside dim.
- Velcro-sealed outer pouch, padded shoulder strap with heavy-duty swivel hooks, zipper closure
- Handsome black vinyl "leather-grain" exterior · Cushiony plush interior protects your
- laptop's case ◆ Quantity discounts available

HSC#17662

(1-800-442-5833)

(408) 732-1573

http://www.halted.com



#### Visit HSC's Website!

- Pay us a virtual visit on the World Wide Web! Simply point your browser to http://www.halted.com
- Site is constantly being revised, please visit often! Or, you can email your order to hscmail@halted.com
- HSC Catalog online!
- That's right, get HSC's catalog on the World-Wide Web! Simply go to www.halted.com and follow the big red link.
- Adobe .PDF files are available for download and viewing.
- ♦ Or drop on by and pick one up...we'd love to see you!

Terms: Some quantities limited; all items subject to prior sale. Minimum order: \$10.00 plus shipping. Orders under \$20.00 subjeto \$2.00 handling fee, in addition to shipping. All orders shipped FOB Santa Clara, CA (this means you pay freight!) by UPS Surfaction FO. Boxes) unless otherwise specified, in which case prevailing carrier rate plus \$5.00 handling fee applies. Prepaid orders the don't include shipping charges will be shipped freight COD. There is a \$5.00 UPS charge added to shipping charges for COD shipment if you have questions about your order, please call Customer Service at (408) 732-1854 M-F 9AM to 5PM PST.

#### Haited specialties co.



#### Electronic Supply

Internet World Wide Web: 3500 Ryder St., Santa Clara, CA 95051 4837 Amber Ln., Sacramento, CA 95841

Toll Free (Orders Only) 1-800-4 HALTED

(916) 338-2545 5681 Redwood Dr., Rohnert Park, CA 94928 (707) 585-7344

FAX your orders to: (408) 732-6428



# COUNTER



Optoelectronics presents the NEW Multicounter CD100 Counter / Decoder. The **Multicounter** combines a frequency counter and tone decoder in one handheld package. As the Multicounter locks onto a nearby RF signal, the frequency along with either CTCSS, DCS, LTR, or DTMF is instantly shown on the two-line LCD display. Like the popular Optoelectronics Scout, the

> ORDER MOM

Multicounter also **Reaction Tunes** many radios for instant monitoring

of the frequency captured.

The **Multicounter** is so easy to operate that it is ideal for quick radio checks by a two-way radio technician or the hobbyist looking for unknown frequencies and tones.

#### FEATURES

- •10MHz 1GHz Frequency Range
  •Measures frequency and tone in < 1 second
  •Decodes CTCSS, DCS, LTR, and DTMF
  •LTR displays Area code, Go to Repeater, Home Repeater, ID, and Free repeater
  •Built-in .5ppm TCXO for accurate frequency measurement
  •Reaction Tune the ICOM R10, R7000, R7100, R8500, R9000, AOR
  AR8000, AR8200,

- OS456/Lite, OS535, Optoelectronics R11, and Optocom.

  •Two Line LCD Display with EL backlight

  •Internal memory for frequency / tone measurement

  •Download memory to PC with optional Optolinx PC interface

  •Patented Digital Auto Filter

5821 NE 14th Avenue • Ft. Lauderdale, FL 33334 • Visa • MasterCard • C.O.D. • Prices and Specifications are subject to change without notice or obligation

Tel: 954-771-2050 Fax: 954-771-2052 Email: sales@optoelectronics.com Internet: www.optoelectronics.com

Reaction Tune Scanner Not Included

Published Monthly By T & L Publications, Inc. 430 Princeland Court Corona, CA 92879-1300 (909) 371-8497 FAX (909) 371-3052

E-Mail - editor@nutsvolts.com URL - http://www.nutsvolts.com

> Subscription Order ONLY Line 1-800-783-4624

PUBLISHER Jack Lemieux N6ZTD

EDITOR Larry Lemieux KD6UWV

MANAGING EDITOR Robin Lemieux KD6UWS

ON-THE-ROAD EXHIBIT COORDINATOR Audrey Lemieux N6VXW

> SUBSCRIPTIONS Abby Madain

**CLASSIFIED ADS** Natalie Sigatus

DISPLAY ADS Mary Gamar

Copyright 1999 T & L Publications, Inc.

All Rights Reserved

All advertising is subject to publisher's approval. We are not responsible for mistakes, misprints, or typographical errors. Nuts & Volts Magazine assumes no responsibility for the availability or condition of advertised items or for the honesty of the advertiser. The publisher makes no claims for the legality of any item advertised in Nuts & Volts. This is the sole responsibility of the advertiser. Advertisers and their agencies agree to indemnify and protect the publisher from any and all claims, action, or expense arising from advertising placed in Nuts & Volts. Please send all subscription orders, correspondence, UPS, overnight mail, and artwork to: 430 Princeland Court, Corona, CA 92879.

	10. Ham Gear for Sale37	120. Components	.58
	20. Ham Gear Wanted37	125. Microcontrollers	.58
0	30. CB/Scanners37	130. Antique Electronics	.58
6	40. Music & Accessories37	135. Aviation Electronics	.58
Index	50. Computer Hardware37	140. Publications	.58
_	60. Computer Software39	145. Robotics	.58
P	70. Computer Equip. Wanted40	150. Plans/Kits/Schematics	.59
ď	80. Test Equipment40	155. Manuals/Schematics Wanted	.59
	85. Security42	160.Misc. Electronics For Sale	.59
e	90. Satellite Equipment55	170. Misc. Electronics Wanted	.60
assified	95. Military Surplus Electronics55	175. BBS & Online Services	.61
SS	100. Audio/Video/Laser55	180. Education	.61
G	110. Cable TV56	190. Business Opportunities	.61
0	115. Telephone/Fax57	200. Repairs/Services	.61

Advertiser's Index ... 66 Classified Ad Info ... 66 Dealer Directory ... 72 Events Calendar ... 18 New Product News ... 93 News Bytes ... 12 NV AdMart ... 84-86 NV Bookstore ... 6 Prize Drawing ... 7 Reader Feedback ...12 Tech Forum ... 68

**VOLUME 20 • NO. 10** OCTOBER 1999

#### AMATEUR ROBOTICS NOTEBOOK

Building a software-only I2C master. Robert Nansel

**ELECTRONICS Q & A** 

TJ Byers

OPEN CHANNEL

A little digression: a "boatanchor" kit, plus more on the AD8307 chip, the lightning detector revisited, hybrid couplers, and the Magic-T transformer. Joe Carr

STAMP APPLICATIONS

Faster, stronger, better: the BASIC Stamp 2-SX.

Lon Glazner

NUTS & VOLTS MAGAZINE (ISSN 1065-2035) IS PUBLISHED MONTHLY FOR \$19.00 PER YEAR BY TEL PUBLICATIONS, INC., 430 PRINCELAND COURT, CORONA, CA 92879. APPLICATION TO MAIL AT PERIODICALS POSTAGE RATES IS PENDING AT CORONA, CA AND AT ADDITIONAL MAILING OFFICES. POSTMASTER: SEND ADDRESS CHANGES TO NUTS & VOLTS MAGAZINE, 430 PRINCE-LAND COURT, CORONA, CA 92879-1300.

8

29

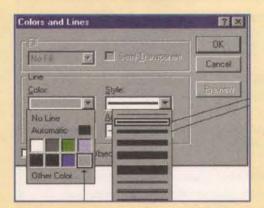
43

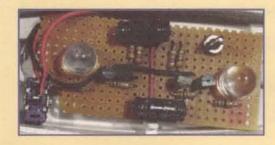
50

53

73







#### PRACTICAL Y2K PRECAUTIONS

With the dawn of the new millennium fast approaching, now is a good time to take a look at some common-sense precautions. Kenton Chun

#### **AUDIO DESIGN WITH OP-AMPS**

Learn some techniques that help "fill in the gaps" in standard op-amp design for high quality, low noise audio circuits. You'll get the basic formulas you need to get started, plus a few not so well-known tricks. Thomas Henry

#### POWERPOINTING YOUR PROJECTS - PART 2

78

22

62

14

This installment shows the construction of another PowerPoint template — one that will allow us to create artwork for making PC boards. Steve Daniels

#### ATMOSPHERICS ENHANCE VHF/UHF/SHF RADIO RANGE

There is no coincidence when summer and fall weather bring enhanced radio range to frequencies 100 MHz to 10,000 MHz. Gordon West

#### **AUTOMATIC NIGHT LED**

Make several useful, practical, portable lights using LEDs. Evert Fruitman

#### SERVOS, STEPPERS, AND OPTICAL ENCODERS — PART 3

Which one works best in your robotic or R/C project? This month: bipolar stepper motor electronic controllers.

## Build your electronics library at a price you can afford!! Order now from the Nuts & Volts Bookstore!!



\$34.95

"Programming and Customizing the BASIC Stamp Computer" by S. Edwards

Build smart electronics projects with the inexpensive, simple-to-use, surprisingly powerful BASIC Stamp.



\$39.95

"Encyclopedia of Electronic Circuits" Vol. 7 by R. Graff

An extensive library of 1,000 circuits from the bestselling, seven-volume "Encyclopedia of Electronic Circuits."



\$54.95

"Handbook of Microcontrollers " by M. Predko

This much-needed reference is the first to cover all the most common types of eight-bit microcontrollers.



\$44.95

"Handbook of Radio and Wireless Technology" by S. Gibilisco

A comprehensive compendium on the entire field of radio and wireless technology.

#### **October's Featured Titles**

by Joseph J. Carr



SECRETS OF RF CIRCUIT DESIGN

\$29.95

From one of today's most respected elec-

tronics authors comes this pragmatic, intermediate-level guide to designing, building, and testing all types of radio frequency circuits. Filled with functional projects that demonstrate the principles of RF circuits, this revision of a bestseller also provides a handy parts list and sources of components.



PRACTICAL ANTENNA HANDBOOK

\$49.95

The most popular book on an-tennas ever

written, widely known as "the antenna builder's bible." This Third Edition is a work for anyone with an interest in antennas, from the newest of novices to the most experienced engineer. This empowering book gives you all kinds of projects and material that explains why what you did works.

# As a <u>paid</u> subscriber to **Nuts & Volts**, you'll receive a <u>10% discount</u> off the listed price shown here!!



\$39.95

"Circuit Troubleshooting Handbook" by J. Lenk

This handbook gives full descriptions of the operation of important circuits, and how each circuit's characteristics may figure in its failure or poor performance.



\$24.95

"How Electronic Things Work ... and What to Do When They Don't" by R. Goodman

Never again be flummoxed, flustered, or taken for a ride by a piece of electronic equipment with this fully illustrated, simple-to-use guide.



\$34.95

"Electronic Troubleshooting" by D. Tomal and N. Widmer

Troubleshoot and repair any type of electronics with this comprehensive guide.



\$39.95

"Programming and Customizing the 8051 Microcontroller"

This tutorial/disk package details the features of the 8051 and demonstrates how to use these embedded chips to access and control many different devices.

#### **BOOKS PUBLISHED BY MCGRAW HILL**

"The Illustrated Dictionary of Electronics" by S. Gibilisco \$39.95

"The Robot Builder's Bonanza" by G. McComb \$18.95

"Programming and Customizing the PIC Microcontroller" by M. Predko \$34.95

"How Radio Signals Work" by J. Sinclair \$24.95

"Making Printed Circuit Boards" by J.L. Axelson \$22.95 VILABLE TITLES

"TAB Encyclopedia of Electronics for Technicians and Hobbyists" by S. Gibilisco **\$69.50** (Hard Cover)

"How to Read Electronic Circuit Diagrams" by R.M. & Lawrence Brown \$19.95

"Build Your Own Test Equipment" by H.L. Davidson \$22.95

"Radio Receiver Projects You Can Build" by H.L. Davidson \$21.95

"Basic Electronics Theory" by D.T. Horn \$26.95

R AVAILABLE TITLES

"Troubleshooting and Repairing Consumer Electronics Without a Schematic" by H.L. Davidson \$24.95

"Amateur Radio Encyclopedia" by S. Gibilisco \$50.00 (Hardcover Only)

"Ready-to-Build Telephone Enhancements" by D.T. Horn \$17.95

"The Benchtop Electronics Handbook: 260 Most Common Popular Electronics" by V. Veley \$65.00 (Cloth Cover)

DERING INFO

Send check or money order to Nuts & Volts, 430 Princeland Court, Corona, CA 91719. Include a complete shipping address (no P.O. Boxes, please). Shipping & handling \$4.50. CA residents add 7.75% sales tax. Or, call our toll-free order-only line at 1-800-783-4624 and use your MasterCard or Visa. ALL ORDERS MUST BE PREPAID.

Call 1-800-783-4624 today!

WE ACCEPT VISA AND MASTERCARD

OCTOBER DRAWING HOSTED BY Seabird Technical (see page 85)

Stereo Microscope

August Prize Winners:

Rickey Hughes

of Providence, UT **Edward Cunningham** of Candia, NH

Subscribe today and be automatically entered in our new MONTHLY PRIZE DRAWING

SPECIAL BONUS: NETCOM (page 21) WILL FURNISH PRIZES MONTHLY!!

Check us out on the web! http://www.nutsvolts.com

If you do not wish to order a subscription, but would like to be entered in our drawing, simply send or E-Mail your name, address, and telephone number, to NUTS & VOLTS. 430 Princeland Court, Corona, CA 91719, drawing@nutsvolts.com. No phone entries accepted. All orders/entries must be received by the last day of the month to be included in that particular month's drawing.

As a current, paid subscriber, you will be automatically entered each month in our drawing.

To Subscribe - Just fill in and mail the enclosed subscription card or call our toll free order line at (800) 783-4624 with a Visa or MasterCard.

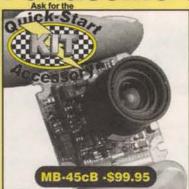
#### Contributors ...

ou Win with Nuts & Volts

Parallax (back cover) • Corporate Systems Center (pages 2,95) • HSC (page 3) • Resources Unlimited (page 28) • Timeline, Inc. (September issue, page 37)

- Alltronics (page 13) Electro Mavin (page 25)
- All Electronics (page 75)
   Roger's Systems Specialist
  - (page 19) Electronic Goldmine (page 87)
    - MCM Electronics (page 27)
  - Velleman (page 37)
     Seabird Technical (page 85)

## asonic Color Camera Micro Video Specialist



Size: 1.25 x 1.25 sq. w/ Footprint

Cameras with Euilt-in Infrared Illuminators.



- Wide Voltage Range, 5-12 Volts! Horizontal Res. More than 380 lines.
- Small Footprint!
  Self contained ultra small package

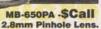
- design for various applications.
  MCM PCB design for minimizing the size and improve durability.

#### **Flat Screen TFT-LCD Monitors**

TFT-4 \$179.95 Color 4" Screen. (Size: 6"(W) x 4.5"(H) x 2"(D) An excellent 4" monitor for one camera monitorine or for setting up cameras during installation or maintenance. Color



MB-650a Series Built-In Audio • 1.18" sq. • 380 TV Line





MB-650UA -\$Call

MB-750P -\$Call MB-750U -\$Call MB-750 Series

• 1.25" sq. • 420 TV Line

H HATT H

Call and Compare! We Match or Beat All Prices!

#### The Door Video Camera Is Designed to replace a **Standard Front Door** Peep Hole! For Home or Office.

 Shipping/Receiving.
 Employee Entrance.
 Viewing without Moving. Fee Video & Pov



W IRELESS TRANSMITTER M ODULES Makes any Camera Wireles

When wires are impossible to run, our wireless transmitters & receivers are lightweight and excellent for Hobbyist or Remote Control-Airplanes, Boats & Helicopters enthusiast. Small enough to place anywhere. Can operate off of 12VDC or Battery power supply.

attery power supply.

MPX-900HP
900 Mhz High Power \$Call
MPX-900
900 Mhz \$119.95
MPX-1200
1.2 Ghz \$149.95
MPX-1300
1.3 Ghz \$149.95
MPX-2400



GW-2400S - \$449.95 Includes: 2.4 Ghz Color "Portable"

Wireless Camera. Receiver with Built-In Monitor

Color Wireless System



Polaris Industries http://www.polarisusa.com 470 Armour Drive NE • Atlanta GA 30342-3943 • Tech Info 404.872.0722 • FAX 4-4.872.1038



IL

100's of Video Products

## PROTICAL Y2K PRECAUTI

by Kenton Chun

ne of the more humorous comments I have heard about the impending Y2K phenomenon is that if it weren't for the people who insist on abbreviating stuff like "Y2K," we wouldn't be in this fix in the first place. But now that we are staring it in the face, it is a good time to take a look at some practical Y2K precautions.

By far, the greatest danger of Y2K is in simply assuming that you will be unaffected. If you think you are already prepared, try this simple test. If your computer runs "Windows," click on control panel, regional settings, date. If your short date reads M/d/yy, you were not prepared. Windows defaults to the short date for year, "yy." On New Year's Day, all of the dates in your computer would read "00." It is easy enough to change, but relatively few people are aware that "Windows" automatically defaults to the short date.

As hardware hackers, it is per-

By far, the greatest danger of Y2K is in simply assuming that you will be unaffected.

haps even a little bit exciting to imagine employing technology to battle natural disasters. However, it is important to realize that survival is the only factor to consider when disaster strikes. Should the worst possible scenario develop, excessive technology can become a hindrance instead of an asset. Part of the horror of contemplating a breakdown of our technological infrastructure is imagining how we would survive if suddenly we were without the things we often take for granted.

One of the assignments I give to technical writing students is to have them write a paper describing three items they would take with them if they were put into a

time machine and permanently transported back to a more primitive era in the past. The three items would have to aid in their survival and could not be used to create or contribute to a time paradox. I am constantly amazed by the numbers of students who decide to take laptop computers, digital cameras, and compact disk players back with them to the 12th

There are three top priorities to surviving a natural disaster. In order of importance, you need water, shelter, and food. Without water, you will last one or two days, depending on the environmental conditions. Without shelter, you can last a few days, unless the conditions are extreme, in which case, the time can be even shorter than being without water. Without food, you can go for perhaps a

Since Y2K is probably not going to destroy your house, you are best off staying there. Grabbing a sleeping bag and heading for the hills is far more likely to get you into trouble than staying put. For most people, Y2K effects will be most noticeable in the first quarter of the year 2000 and, unless you live in Miami or southern Arizona, it can be cold!

#### WATER

Clearly, applying the priorities I mentioned above, your first thought should be about how you can protect or guarantee your water supply. With recent concerns about municipal utility Y2K preparedness, it may be a good idea. If you have a water well, you are in good shape. Make sure you can get potable water out of it, either manually, or by means of an electric pump.

Standard deep-well or jetpumps have enormous start-up current requirements, and many generators are not up to the task of starting them. You need to do some experiments to see if you have the electrical backup load capacity to start them. If not, put together a DC pump arrangement which will run off a battery that will pull enough water out of the well to provide at least two gallons of water per member of the family, per day. If the well is exposed to the outdoors, consider building an insulated structure around the wellhead to prevent freezing (Figure 1).

If you do not have a well, your only alternative is to "stockpile" water in some form or another. Start saving up gallon water or milk jugs now. If you are lucky enough to have a cistern or large water tank, this can be employed, but remember that these will require careful monitoring of the water quality to prevent contaminants from becoming an issue. Treating the water with a small amount of bleach will help.

#### SHELTER

If systems fail below freezing, pipes can burst. Since you could lose electrical power, you may not have the kilowatts to heat an entire house and may be forced to retreat into a smaller zone. Make

sure you have insulated the pipes that are in the extremities of the house to minimize the chances. they will freeze and burst. Shut off outdoor spigots and cover them with Styrofoam casings available at your hardware superstore.

Last winter, an interesting phenomenon occurred in Maine during the great ice storm. Newer houses were not constructed with traditional iron stoves or fireplaces and, when the ice cut off power lines, people with full tanks of heating oil nearly froze anyway because they didn't have any power to run a simple furnace blower! If you have gas or oil heat,

take a careful look at the power requirements of the oil pump and



A small solar pump supplies 2GPH



blower to see what you will need to supply them. Amazingly, the

Yak + Yak +

power requirements for these items are surprisingly low. A moderate capacity power inverter and battery may actually be enough to run it, if sized properly. Something along the lines of a 1,000-watt inverter will usually be enough.

Fortunately, most modern furnaces are designed with power failure failsafe modes so, if the power is killed or runs out, the gas supply will automatically be valved off. You should test this to make sure before setting up an alternative backup power supply for your furnace. Be careful when re-lighting pilots!

If you do not have the means to run the furnace in backup mode, clean up your fireplace and start laying in a wood supply. In temperate climates, a cord or two will get you through the winter if conservatively used. Heating efficiencies are higher if you can provide the combustion chamber directly with outside air, instead of pulling in cold outside air through cracks in the house to draft the fire. Now is the time to experiment, not when it is 14 degrees below zero outside.

#### FOOD

Other than a few panic runs, the food supply will probably not "disappear" after New Years. However, if you are prudent, you will stockpile some necessary items, remembering that the daily calorie count must be higher the colder the climate is. Do not lay in hundreds of pounds of frozen food. If the power goes down, it will all. be lost. Buy canned items with decent nutritional value and don't go overboard. Try to buy stuff you would use anyway, after the crisis has passed. This will minimize waste.

If you have gas service, consider renting or buying a backup LP gas bottle that you can "valve" in somewhere after the main. If the gas utility should fail, you can then cut the main valve and go on

Other than a few panic runs, the food supply will probably not "disappear" after New Years.

backup. If you don't have experience in doing this, get a professional installer to do it for you. Don't look for an installer on New Year's Eve.

If you have electric cooking, forget it. Electric stoves use far too much power to be practical in an emergency. In this case, you are better off buying a propane camp stove. Don't use a camp stove indoors or you could die of carbon monoxide poisoning!

Fill your freezer with as much



ice as you can get into it. This will create a "cooling capacitance" which will help to maintain low temperatures through power hits. The refrigerator is also a good place to store the jugs of potable water you prepare. If they are not filled to the very top, they can be frozen as well.

#### TECHNOLOGY

The American Red Cross says the formula for panic is based on three factors. The first is a situation that is out of control that has no escape. The second is a lack of communication. The third is a perception of imminent danger.

If you are in control of the survival factors I mentioned above, the first panic factor is alleviated. For the second and third factors, technology can help.

#### COMMUNICATIONS

For years, American ham radio operators and the ARRL have supported emergency communications in times of national crisis and disaster. Many of the techniques developed by ham radio can be applied here.

Start by putting together a short list of simple items in your house that can be used to enhance communication.

The cellphone is okay, but after a major disaster, the cell transceivers may be down or congested. If cellphone is your only means of communication, consider switching back to a system that has both analog and digital coverage. Analog coverage, while some times of poorer quality, will have far more cell coverage sites than



digital systems. At the same time, you may wish to put together an alternative.

In remote areas, the old CB radio can still be used. Many police and emergency management organizations will monitor CB channel 9. If you are a licensed ham, even better. Now is the time

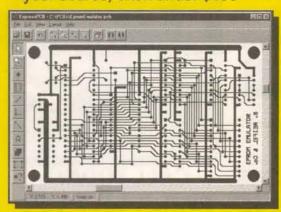
The perception of imminent danger often results from misinformation or the lack of information altogether.

to tune up the "shack" and establish your network of communication in the event of emergency.

Get an AM-FM portable radio

## Software For Win95 - *FREE*

- Download our board layout software
- 2 Design your 2 sided plated-through PCB
- 3 Send us your layout over the Internet
- In 2-3 business days, UPS delivers your boards, often under \$100



www.expresspcb.com

## PIC'n Books

LEARN ABOUT PIC MICROCONTROLLERS



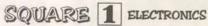






See Table Of Contents: http://www.sq-1.com Secure Online Ordering Is Available

PIC is a trademark of Microchip Technology Inc.





Voice (707) 279-8881 Fax (707) 279-8883

http://www.sq-l.com

Analog coverage, while sometimes of poorer quality, will have far more cell coverage sites than digital systems.

that will run on a readily-accessible alternative power source. I like 12volt devices because of the ease of finding 12-volts - a car battery, or a pair of Trojan T105 six-volt golf cart batteries wired in series, like I have in my home (Figure 2). The same goes for the television.

Try to avoid monster sized TVs; they will eat power you don't have. Also, look for portable televisions that do not have "instant on" features. This means that they draw idle current in standby mode all of the time. You don't want a constant draw on a limited power source like a battery if you can help it. Otherwise, disconnect the devices from the power source when you are not actually using

A good radio or television will supply you with much of the information you will need to survive the

Lighting is another problem. If the lights go out for extended periods of time, it will be impossible to do anything at night. Set up some low-voltage lighting now. I have found that small halogen spot-

Get an AM-FM portable radio that will run on a readily-accessible alternative power source. lights throw a great deal of light and have low power consumption. Set up a few 25-watt halogen spotlights in critical areas of the house like the kitchen and living areas. You can run a few of these for days on a good car battery. If you charge the battery regularly, either through solar panels or by running the car alternator, this will provide you with dependable lighting almost indefinitely (Figure 3)

I have found that an inexpensive Japanese-style lamp shade does a very nice job of hiding both the primary and the backup light sources (Figure 4). If you are fortunate enough to live in an area of the country where solar energy is plentiful, consider solar panels as a possible alternative for charging a battery. Solar panels are silent, "green" (environmentally friendly), and have a long operational life (Figure 5).

Get to know your automobile again. This time, calculate your "mileage" at zero miles an hour. This means if you use the car as a battery charger, figure out how long it will run at idle. In this case, the smaller your car, the better. To get a sense of this, take a look at your worst-case scenario. If your car gets 30MPG on the highway, you are burning approximately a gallon of gas per hour (in one hour, you are traveling 30 miles on a gallon of gas, assuming about 60 miles an hour of speed).

If your gas tank capacity is 10 gallons, you have a 10 hour capacity at this load. Idle loads are far less, so you can estimate far more time just charging batteries, but you may want to do an idle fuel consumption test to know exactly



what you can expect. Just pick a day, and with a full tank of gas, turn on the headlights and the radio and run the car at idle for an hour. Then top off the tank and divide the tank capacity by the amount you just put back in. That's how many hours you have. Don't run the car in enclosed spaces like the garage because the exhaust gases can kill.

#### INFORMATION RESOURCES

Nuts & Volts is a great place to start. Review my UPS Conversion article in Dec. '97, and the Solar Power articles in Aug.

'99. You can get a good idea of the practical limitations and advantages of setting up solar power alternatives. There have been a couple of other good articles about Y2K in this magazine. Get informed. Use the Internet and take what you read with a grain or two of salt.

The perception of imminent danger often results from misinformation or the lack of information altogether. Being caught in an elevator when the power goes out is not particularly dangerous because since Otis, elevator cars are counterbalanced, and equipped with safety brakes Although the elevator will never go plunging to the basement killing all aboard, one of the passengers going "berserk" very well may.

Y2K has been a sobering experience to those who depend on technology with their lives and for their livelihood.

For this reason, it makes sense not to be travelling or in an uncontrolled environment on New Year's Eve or shortly after. It's not technology so much that needs to be feared, but uninformed people who are in a blind panic.

Y2K has been a sobering experience to those who depend on technology with their lives and for their livelihood. For the hardware hacker, it is a chance to let one's imagination run wild and to use the creative process for preparation. For the vast majority out there, it will be worst-case, a chance to catch up a bit on one's reading. This magazine is a great place to start. Remember to have fun whatever you do! NV

#### **Network Service Tool Set**

Popular installation and service tools for networks, modems and telephones. All hand tools are professional heavy duty type.

Use the compact tester on 10BASE-T (UTP & STP), thin Ethernet (BNC), 8-position Token Ring, AT&T 258A and EIA/TIA 568A/B. Automatically scans cables for continuity, wiring sequence and polarization. Tests STP cable ground. Testing installed cables is easy with Remote Terminator and gender changers (UTP and BNC). 9V battery included.

- Coax Stripping Tool, RG-58 & RG-59
- BNC Crimping Tool, RG-58 & RG-59
- Modular Cutting/Stripping/Crimping Tool (4, 6 & 8-Position)
- Multi-Network Cable Tester
- AC Receptacle Tester
- Cable Cutter

Order No. 55625 \$197.00



#### PC Diagnostic Tool Set

- AMI Diagnostic Software
- POST Card

Order No. 55555 \$98.00

#### **Network Installation Tool Set**

 Network Tool Set 55625 without the Multi-Network Cable Tester.

Order No. 55600 \$99.00 Call for your FREE Catalog

rayma

P.O. Box 2015 Tustin, CA 92781 http://www.labvolt.com

## PC Service Tool Set

Contains all tools needed to troubleshoot & service IBM-compatible PCs. Set includes:

- AMI Diagnostic Software
- POST Card
- Logic Probe
- Digital Multi-Meter
- AC Receptacle Tester Serial Adapter
- · Serial & Parallel Loopback Connectors
- DIP IC Puller
- PLCC IC Puller
- Grounding Wrist Strap
- Key Top Puller

Order No. 55000 \$198.00



**CALL TODAY!** 800-854-7393









CALL TOLL FREE

(800) 292-7711 Orders Only

Se Habla Español

## C&S SALES

**Excellence in Service** 

CALL OR WRITE FOR OUR FREE

**64 PAGE CATALOG!** (800) 445-3201

#### Digital Multimeters

Elenco Model LCR-1810

Elenco Model M-1740



- Freq. to 20MHz · Cap. to 20uF

- Beeper Diode Test

Model M-2760 - \$24.95 (9 functions)



- ice full to 20H
- Resistance .01Ω to 2000MΩ
  Temperature -20°C to 750°C
  DC Volts 0 20V
- Frequency up to 15MHz
   Diode/Audible Continuity

#### Fluke 87III



Features high performance AC/DC voltage and current measurement, frequency, duty cycle, resistance, conductance, and capacitance measurement.

Series II (limited qty.) \$289

#### **Generators and Counters**

**Elenco Sweep Function Generator** with built-in frequency counter Model GF-8036



This sweep function generator with counter is an instrument capable of generating square, triangle, and sine waveforms, and TTL, CMOS pulse over a frequency range from 0.2Hz to 2MHz.

20MHz Sweep / Function Generator with Frequency Counter **Model 4040** 



- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation

14 Channels

**Key Lockout** 

Lightweight

Palm Sized

**Battery Monitor** 

Monitor Button

Large LCD Display Removable Belt Clip

Removable Antenna

Two Radio Call Tones

External Frequency counter to 30MHz

**Tekk Radios** 

**Pro-Sport FRS Two-Way Radio** 

Model PRO-SPORT+

79 each

or

149.95

Set of 2

Linear and Log sweep

BK PRECISION

Talk up to

10MHz Model 4017 \$309 5MHz Model 4011 \$239

Elenco Handheld **Universal Counter** 10Hz - 2.8GHz Model F-2800



Sensitivity: <5mV @ 1GHz

Features 10 digit display, 16 seg-ment and RF signal strength bar-

graph. Includes antenna, NiCad battery, and AC adapter.

Elenco RF Generator with Counter (100kHz - 150kHz) Model SG-9500



Features internal AM mod. of 1kHz. RF output 100MV - 35MHz. Audio output 1kHz @ 1V RMS. SG-9000 (analog, w/o counter) \$119.95

28 tools plus a DMM

contained in a large

flexible tool case with

a handle ideal for

**Elenco Quad Power Supply** 

everyone on the go.

\$89.95

**B&K Frequency Counter** Model BK-1875



.1Hz - 2.8GHz 3 Channels

#### Sensitivity:

- <0.8mV @ 100MHz <8mV @ 300MHz</p>
- <7mV @ 1GHz</p>
- < <100mV @ 3GHz

Ultra sensitive synchronous detector bargraph and strenath.

Elenco 10Hz - 1MHz **Digital Audio Generator** Model SG-9300



Miscellaneous

Elenco Technician Tool Kit

Model TK-1500

\$49.95

HIE S

\$219.95

**Dual-Display LCR Meter** 

w/ Stat Functions

**B&K Model 878** 

Features built-in 150MHz frequency counter, low distortion and sine/square waves. SG-9200 (w/o counter) \$119.95

#### Elenco Oscilloscopes

Free Dust Cover and 2 Probes



25MHz	Dual Trace	\$325
25MHz	Delayed Sweep	\$439
40MHz	Dual Trace	\$475
40MHz	Delayed Sweep	\$569
60MHz	Delayed Sweep	\$749
100MHz		\$995
	25MHz 40MHz 40MHz 60MHz	25MHz Delayed Sweep 40MHz Dual Trace 40MHz Delayed Sweep

#### DIGITAL SCOPE SUPER SPECIALS

DS-203	20MHz/10Ms/s Analog/Digital	\$695
DS-303	40MHz/20Ms/s Analog/Digital	\$995
DS-603	60MHz/20Ms/s Analog/Digital	\$1295

#### Four Functions in One

Elenco Model MX-9300



#### Features:

- One instrument with four test and measuring systems:
- 1.3GHz Frequency Counter
- 2MHz Sweep Function Generator
- **Digital Multimeter**
- Digital Triple Power Supply 0-30V @ 3A, 15V @ 1A, 5V @2A

#### Elenco Educational Kits

Model AR-2N6K



\$34.95

29.95

Radio Kit

Model AK-700

Model AK-870 \$24.95 Radio Control Car Kit 7 Functions Radio Contro Included



Telephone Kit

3 1/2 Digit LCD \$19.95

Model XK-150 Digital / Analog \$89.95

Model XP-720K Power Supply Kit

Model EP-50





\$54.95

0

#### Busy Channel Lockout **Accessory Connector** Highly Water Resistant PRO SPORT Model

\$109.95 set of 2 Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5% OTHERS CALL FOR DETAILS IL Residents add 8.25% Sales Tax

150 W. CARPENTER AVENUE WHEELING, IL 60090 FAX: (847) 541-9904 (847) 541-0710

http://www.cs-sales.com

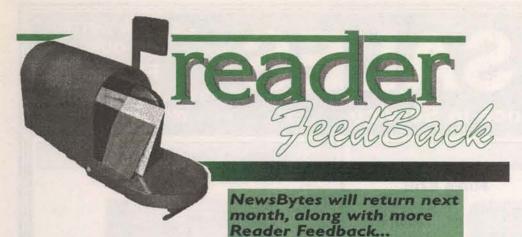
Write in 42 on Reader Service Card.



15 DAY MONEY BACK GUARANTEE

2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE



Dear Nuts & Volts:

A response to John E. Lemmer.

Yes, you're right on the 525 lines. I mixed up this figure with another figure which was the actual usable lines on the TV set which fall between 460 and 490, thus the #480.

Your 1/30 figure, however, is useless without the interlace which is another 1/30 of a second, and thus one full signal each 1/60 of a second, or "60 times" each second?

As to resolution, no you're incorrect. Less lines or pixels mean less resolution, period. There is no way to make up more resolution from less information. The total usable pixels which usually aren't mentioned on inexpensive cameras are always less than the standard TV set, with the exception of scientific cameras which aren't cheap. On top of this, when they mention that there are 410 lines they mean it. "Should have or would have" 525 lines isn't 525 lines and, therefore, there is less resolution. Resolution, by the way, is a mathematic value and not a subjective value given by the user or his eye.

As to the lux question and "the short version" that I wrote for lux, I gave a fairly accurate answer to what lux is, or how lux is measured, or at least understood, and my answer is basically correct. It is a quantitative value of light in a given area being measured, and it is not a scenario based upon an individual item or circumstance or the ability of that given object to reflect or refract light, or anything else.

It is the "after the fact" measurement of that light in that given space. It's approximately (the short version) equal to a value of radiant light exhibiting outward, one candle (candela) worth of light in one cubic meter of free space, at any point of measurement, anywhere within that cubic meter of space.

Measuring one lux of light in scientific terms explains nothing to the layman unless you convert its meaning to something usable to that layman, and thus "one lux of light, or its measurement is approximately equal to one candle worth of light in a given cubic meter of free space."

long If the version 1 gave of (-2) cd. sr, I would have lost all including the scientist when candela and steradian were attempted to be explained. These meanings have no value outside the physicists world of abstract words and meanings. To the layman, one candle and one meter of free space will suffice.

Getting lost in the "f" stop and its meaning has nothing to do with lux, whatsoever. The "f" stop of any lens has everything to do with the way a lens is assembled, out of what materials, what the focal length is, etc., but nothing to do with the external fact of a light source, namely lux. Yes, it affects the input of light inside the camera, after the fact, but it doesn't control the external light quantity known as lux, outside of the camera.

There is a relationship between lux and "f," but they are independent of each other, and they don't control each other until after they enter the camera. Nowhere is there mention in either my writings or the manufacturers writings of any camera, "how to convert" these esoteric numbers or settings to be useful to a layman, nor should there be!

My statement of "mm" as a component of diameter is theoretically correct only when using the "f" value of 1. A lens having an "f" value of one and a focal length of, say, 4mm will be

4mm in diameter. I use these figures "figuratively speaking" to represent what the lens will be like in terms of size or diameter. I realize that this is not an accurate statement across the board, unless you have an "f-1" lens.

As to the answer #7992 and my response, make up your mind. You say I give double talk and then you repeat my words exactly, to the letter, and then say you're right? Where did "not an inherent characteristic" come from? Certainly not my words?

Altering the frequency will "over" heat the windings period! It may or may not be severe enough to do damage, but it will increase the heat in that given impedance winding.

In order to alter the rotation speed of that motor significantly, a large frequency difference would be necessary and thus the overheating will fol-

As to the chopper circuit on drills and lathes, as spoken, they chop badly at slower speeds and on a lathe, at slow speed while cutting, the finish is marred. I know, I have a lathe with both of these units available for use, as well as a drill press. Only the variac works at slower speeds without any noticeable pulsing.

You do not have full control over any single phase motor with either controllers and yes, you lose torque at slower speeds, but they work just fine between 40 and 60 volts AC, and will reduce the rotation speed by a factor of 2/3 depending on your motor, thus fulfilling Mr. Billetts needs. However, they do not respond well to capacitor run motors with only a small amount of control available on these motors.

Yes, the best motor which allows the largest range of variable speed and power is the "brush type AC or DC motor." The answer that was given to Mr. Billett was not an attempt to change his mind, or the motor on his lathe, but was rather an "answer to his question." I filled that need and didn't split hairs.

As to the auto transformers "moving," there was no mention of "physical" movement. As the sweeper moves, one transformer (part) gains from this movement while the other loses from this movement, thus "they move in relationship to each other" via the brush. Again splitting hairs will only make you bald!

As to "remaining a constant current" while the brush is moved, that is exactly what it does. The voltage varies while the current remains (relatively) the same.

A 6-amp variac will deliver 6 amps at 1 volt, 10 volts, or 100 volts with the voltage varying and not the current, as you sweep the arm.

Chris Bieber, CA



A device programming system for design, repair and field service

♦ EXCEPTIONAL POWER FOR THE PRO

**♦** EASY-TO-USE FOR THE NOVICE

Here's what you get: A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters\*. Comprehensive, easy-to-use software which is specifically designed to run under DOS, Windows 3.1. 95 and 98 on any speed machine. The software has features which let you READ, PROGRAM, COPY and COMPARE plus much more. You have full access to your system's disk including LOADING and SAVING chip data plus automatic processing of INTEL HEX, MOTOROLA S-RECORD and BINARY files. For detailed work the system software provides a full screen buffer editor including a comprehensive bit and byte tool kit with more than 20 functions.

comprehensive bit and byte tool kit with more than 20 functions

Broad device support: including FIRST GENERATION EPROMS (2708, TMS2716\*, 25XX etc.)

SECOND GENERATION EPROMS (2716-27C080)(8 MEG), 40 and 42 PIN EPROMS\* (27C1024-27C160)(16 MEG)

EEPROMS (2816-28C010) PLUS ER5901, FLASH EPROMS (28F,29C,29EE,29F)(32 MEG), NVRAMS (12,20,X2210/12)

8 PIN SERIAL EEPROMS\* (24, 25, 85, 93, 95, 80011A) PLUS ER1400/M586657\*

BIPOLAR PROMS\* (74S/82S), SERIAL FPGA CONFIGURATORS (17CXXX)

MICROS\* (874X,875X,87C5X,87C75X,89C) ATMEL MICROS\*(89S,90S)(AVR)

PIC MICROS\* (8, 18, 28, 40 PIN (12CXXX,16C5X,6X7,8X PLUS FLASH & 17C)

MOTOROLA MICROS\* (68705P3/U3/R3, 68HC705C8/C9/1/2PP, 68HC711E9/D3)

Includes step-by-step tutorial plus explanation of EPROM fundamentals
1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE
VISA • MASTERCARD • AMEX

\*\*REQUIRES SNAP-IN ADAPTER (ORDER FACTORY DIRECT OR BUILD YOURSELF)\*\*

\*\*VISA • MASTERCARD • AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OHIO 45150

(513) 831-9708 FAX (513) 831-7562

website - www.arlabs.com

email - arlabs@worldnet.att.net

MADE IN THE U.S.A

BRIGAR ELECTRONICS 7-9 ALICE ST. BINGHAMTON, NY 13904



PHONE: (607) 723-3111 FAX: (607) 723-5202

EMAIL: BRIGAR2@aol.com

http://members.aol.com/brigar2/brigar.html

#### 15" SVGA COLOR MONITOR

Various Manufacturer

IBM PC/XT or Higher compatibles .26 mm dot pitch - Max resolution 1280 x1024 Includes power cable

Weight 32 lbs. Removed

from syce. Mint cond. SALE PRICE \$ 69.95



#### UNBEATABLE COMPUTER SALE

IBM COMPATABLE CPU'S VARIOUS MFG. COMES WITH THE FOLLOWING:

- ■486 66MHZ ■4 MEG & UP MEMORY
- ■170 TO 540 MEG HARD DRIVES.
- ■3-1/2" 1.44 MB FLOPPY DRIVE **■KEYBOARD**

THE COMPUTERS ARE OBVIOUSLY USED **BUT IN GREAT** 

BLOW OUT \$ 59.95

CONDITION.





#### CCD COLOR VIDEO CAMERA

Auto light control, NTSC, 5V camera. Dimensions: 41/2"Long x21/ 2" Wide. Cables, (keyboard plug power adapter for use with PCs and video capture card) included. Runs on 5VDC @ 100mA to use independently of PC (CCTV, VCR,

99V006

\$79.95

### WALLWART

5VDC @ 1.5A regulated power supply. Companion power supply for above camera.



#### SOLENOID VALVE

Teflon body for high purity and/or reactive chemicals- gas or fluid. 24VDC coil. 1/4" NPT ports, 30 psi, working press.

Two way (common to NO or NC). Dimensions: 1 5/8" diameter x 4"

height. 99B001

#### 200W MINITOWER POWER SUPPLY \$14.95

98C042

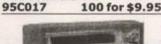


### DEMODULATOR

Originally used in cable TV application, this subassembly takes channel 3, 4 or 5 signal and demodulates the audio. Comes with documentation and schematics. plus additional schematics to build add-on video demodulator board. 92A028 \$9.95 each

#### RECYCLED 4 **DISKETTES!**

1.44MB, 3.5", bulk erased. From unsold software.





#### **BLACK (UV) LIGHT**

Avon "Derma-Spec" imager designed for skin evaluation, but ideal for many other applications. Plastic case contains a UV-B bulb and reflector. Auto turn-off after 50 seconds. Powered by 12VDC @ 500mA wallwart (not included). 981,009 \$7.95 each



#### STEPPER MOTOR DRIVER

Will drive two bipolar stepper motors up to 2A per phase. Board has the following ICs: 3702C, L298N, 74HC00 74HC138 74HC573WM, MS6264L-10FC 74HC374, TL555C, PCA82C200T, HCTL-2000, 24LC16B, 9200ACA, 7705AC, AMD485, D78C10AGF, Approx. 11/2"W x 5"L board with DB-15M connector. 99C001

\$14.95



#### MULTIMEDIA SPEAKERS

Quality sound. Amplified, with cables and power supply. 30 watt. Size: 10.25"H x 2.5"W x 6"D. 98V004 \$19.95 Pair



#### "FLUKE TYPE" METER PROBE KIT

Shrouded type banana plugs fit Fluke and other popular DMMs. \$4.95 set

MINI SPEAKER 80hm, 2W, 2.5° 99V007







#### INTERN A-B SWITCH

12VDC @ 15mA controls relay. Non-latching. Remotely switches between two signals. Specs included.

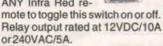
98G001

\$7.95 each

Use 98G001 and Kit 58 together to remotely switch your TV cable antenna!

#### IR TOGGLE **SWITCH**

A very useful kit. Everybody has Infra Red transmitters at home - TV remote, video remote, CD remote, etc. Use ANY Infra Red re-



**KIT 58** 





#### \$19.95

#### **ATARI 1020 COLOR PRINTER**

For all Atari 8-bit computers. (Not PC-compatible!) Package includes: printer, power supply, software, pens, paper and interface cable. These are new units in factory sealed boxes.

\$14.95 each 8 94C037



UNIPOLAR

eter X 7/16" long.

GENERAL

CONTROL

Model XRC11D

QUANTUM

HARD DRIVE

WALL WART

MULTIMETER

990008

SOLDER

5' long solder wick 42C5

WICK

DC volts 5 ranges to 1000V max.

DC current 4 ranges to 200mA

+10A. AC volts 2 ranges 200 and

2MOhm max. Diode and transistor

test. 3 1/2 digit LCD, 0.5% basic

accuracy, low battery indication,

probes included. Power: 9V bat-

tery (Battery life approx. 200 hr. with 9V alkaline).

\$14.95

3/\$1.00

750V. Resistence 5 ranges to

98V011

99C002

14 VDC

700 mA

center (-) 95E021

INSTRUMENTS

X 3/8" thick. Shaft is 5/32" diam-

UNIVERSAL REMOTE

540MB, 31/2", Maverick Pro Drive.

With coaxial connector, 1.5 x 2.5 mm

\$9.95 each

\$4.95 each

STEPPER

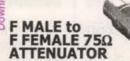
MOTOR

99M002

## COMPUTER CASE & POWER SUPPLY

Mini tower case with 250W power supply, two 5.25" and two 3.5" external bays, plus one internal bay for hard drive. LEDs for power, turbo and HDD.

97C001 \$24.95 each



RF feed thru in the following values: 3, 6, 8, 10, 12, 16, and 20Db. Please specify value upon order-

ing. CF975

\$1.25 each 10 / \$9.95



#### CRIMPING TOOL

Six-position (6P6C, 6P4C, 6P2C) modular telephone plugs. Cuts, crimps and strips. 98Z001

\$9.95 each LASER DIODE

Toshiba TOLD9200. 670nm, 9mm dia. case, 3mW, 2V @ 80mA. 995004 \$14.95



Porcelain. New old stock. MIL-Spec. Original sealed foil bags. 973001 \$5.95 each







#### "T HUNT" TRANSMITTER KIT

Good for "T Hunts," Beacon, CW, Rig, Telemetry experiments, etc. This one-Watt transmitter will operate from approx. 100 MHz to 150 MHz. 24 MHz crystal is included (may be tuned to harmonic). With schematic. Must be modified to frequency of choice. Runs on 9VDC. 99K005 \$24.95 each

#### REGULATED POWER SUPPLY

Rated 3A continuous, 5A maximum. Features include illuminated on/off switch, fuse, binding posts and cigar lighter socket. \$34.95 99E003

#### CONDENSER LAPEL MIKE



Operating voltage 3-9V. Current 50-100µA. Impedance out approx.

93V003 \$4.95 each

## 50-LB. CARE PACKAGE

Surplus goodies from Silicon Valley. This is not junk, just material we've acquired in quantities too small to catalog - electronic and mechanical subassemblies for everything from robots to rockets. Assortments may include ICs, caps, connectors, bearings, di-odes, hardware, circuit boards, cables. Weird and wonderful stuff. Most folks are happy with the assortments we send and we often get re-orders. Try one. 92U034 50 Lbs. /\$49.95





Creative Labs #CT1870. (For individual cards, see 96C012). Dealer inquiries invited.

98C007 Box of 20 \$19.95

### MOTOR



#### UNIPOLAR STEPPER MOTOR DRIVER IC

UCN5804. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 1.25 Amps per phase. Step and direction input. Drive with a 555 timer, parallel port, etc. Build your own robot, anything that requires precision positioning. 931002 \$4.50 each

#### COMBO PACK!

One 931002 IC and 92M010 motor (both shown above) with schemat-931003

\$7.95/set

## 2300-D Zanker Road - San Jose, CA 95131-1114

World Wide Web: http://www.alltronics.com (408) 943-9773 - Fax (408) 943-9776

Shipping Additional on All Orders Prices Subject to Change Without Notice Prices Good 60 Days from Date of Publication VISA

Store Hours: 9-6 M-F & 10-3 Sat. - Pacific Visa, M/C, AmEx Accepted.All Sales Final. California Residents Add Sales Tax.







Visit our website and download our catalog.

9909

Download our latest catalog at http://www.alltronics.com Download our latest catalog at http://www.alltronics.com

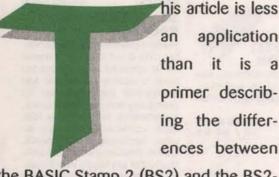
Download our latest catalog at http://www.alltronics.com

## STAMP by Lon Glazner

## APPLICATIONS

#### Putting the Spotlight on BASIC Stamp Projects, Hints, and Tips

Faster, Stronger, Better: The BASIC Stamp 2-SX



the BASIC Stamp 2 (BS2) and the BS2-SX. There are some minor hardware differences, a few new commands, and some timing differences in a handful of the older BS2 commands. But, in general, the learning curve to upgrade from the BS2 to the BS2-SX could be best described as a gently sloping incline.

#### Overview

I've been somewhat remiss in not writing a column on the BASIC Stamp 2-SX (BS2-SX) that was released by Parallax quite a few months ago (actually unveiled November 1998). I was really waiting for an application that required the additional speed and program memory available in this new member of the Stamp family. Of course, I tailor my applications in this column so that they fit into a format that can be well described in just a few pages. It dawned on me this month that that process would likely prevent me from defining applications that "required" a BS2-SX.

So, I'm making it a point to describe

Parallax's BS2-SX in this article, and use it for applications in the next couple of issues of *Nuts & Volts* Stamp Applications.

#### **Defining The Design**

As I mentioned earlier, this article shouldn't be considered a design in and of itself. But it is the jumping-off point for an application making use of some of the BS2-SX features. Next month, we'll be going into an in-depth application called StampNet. StampNet will cover some of the intricacies of a well-defined RS-485 network. This will include electrical requirements, as well as a Master-Slave communication protocol. The StampNet design will be a generic overview that describes a multi-node network. Many electronic disciplines will be touched on during the StampNet application, and the BS2-SX will be the heart of this system.

#### **What's Different**

So what's the big difference between the BS2 and BS2-SX? On first glance I'd have to say the color! Yep, the BS2-SX comes with a new shiny blue paint job. In fact, it is somewhat reminiscent of the midnight-metallic-blue paint job

of the '71 Mustang that I had in high school. But, like the Mustang, what really counts is what is under the hood.

But on the electronics front, I would have to say that the most significant difference between the BS2 and the BS2-SX is the Scenix Semiconductor SX28AC that Parallax designed into the BS2-SX. This processor can operate with a much faster oscillator than the previous Microchip PIC16C57 based BS2. With this speed increase of 250% comes an operating current increase of 750%. But we all knew that no improvement comes without a price. Our price is increased power dissipation, and additional operating current.

One of the easiest ways to visualize all of the differences between the BS2 and the BS2-SX is with a side-by-side comparison. So, in Figure 1, it is in tabular form.

There are three major improvements that warrant discussion with

regards to the BS2-SX. The first

is the massive increase in memory available for program storage. There are now eight 2K byte blocks available for program storage. This huge increase in program memory does have one drawback. The memory is not contiguous. In other words, these memory blocks can not be crossed with GOTO or GOSUB commands (or straight line coding). Each 2K byte block should be considered a separate program, and is defined as such in the BS2-SX manual.

1111

This is not to say that you can not fully utilize the eight separate blocks of program memory. The new RUN command allows you to switch between the eight different program blocks. This aspect of the BS2-SX is described in more detail in the New Commands and Code Example sections which follow.

A second difference exhibited by the BS2-SX is also related, to a degree, to the program memory block requirements. The BS2-SX has 63 bytes of user-accessible scratch pad RAM

	BS2	BS2-SX
processor	PIC16C57	SX28AC
program execution speed oscillator frequency program memory variable RAM user scratch pad RAM	4000 inst./sec. 20MHz 2k bytes 32 none	10000 inst./sec 50MHz 2k bytes x 8 32 63 bytes*
operating current - normal	8mA	60mA
operating current - SLEEP sink/source I/O	100uA	200uA
limitations command set (number	25mA/20mA	30mA/30mA
of)	36	39

Figure 1: Major Differences Between the BS2 and BS2-S3
'64 bytes actually, but address 63 is a read-only byte so I didn't include it.

#### EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE and flash (28, 29) to 32 pins

Inexpensive - Best for less than \$200

- Correct implementation of manufacture specified algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc.
   Free updates via bbs or web.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.



#### M<sup>2</sup>L Electronics 970/259-0555

Fax:970/259-0777 250 CR 218 Durango, CO 81301 CO orders please add 7% sales tax.

cO orders please add 7% sales tax.

http://www.m2l.com



## LASERS & ACCESSORIES

#### **HELIUM NEON LASERS**

- Complete Systems
- Plasma Tubes
- Power Supplies

#### ACCESSORIES

- P Optics
- ☑ Electro-Optics
- IR Viewers
- Books & More



#### DIODE LASERS

- ☑ Visible / IR
- Complete Modules
- **☑** Collimating Optics
- ☑ Drive Circuits

#### FREE CATALOG

WEB SITE:

www.

mi-lasers.com

Phone: 602-934-9387 • Fax: 602-934-9482

STRUMENTS

#### STAMP APPLICATIONS

(really 64, but see the asterisk below Figure 1). This scratch pad RAM is somewhat different, and in addition to, the 32 bytes of variable RAM available in the BS2. As previously stated, each program memory block (0-7) is considered a separate program accessed by the RUN command. You may pass variable data between programs. One method of doing this is to ensure that your variable definitions are defined exactly the same for all programs that are accessed. Another, more eloquent, method of doing this involves the use of the scratch pad RAM.

Using the GET and PUT commands, byte-sized pieces of data may be stored or retrieved from the scratch pad RAM. For instance, if program 0 needs to pass two byte-sized variables to program 6, you would use the PUT command to store each byte and then execute a RUN 6. Program 6 would define the variables that it needs, and then use the GET command to retrieve the data stored in scratch pad RAM.

While on the subject of memory storage, I should also touch on the use of the READ and WRITE commands which are used to store data in unused portions of EEPROM (program memory) in the BS2 and BS2-SX. These commands still function as they did in the BS2. But each of the eight (0-7) possible programs in the BS2-SX can only access EEPROM that is unused in their own 2K byte section of program memory.

Therefore, you could not power up, store data in an EEPROM location, execute a RUN command, and then retrieve the same data from EEPROM while in your second program. The data desired would be in a different 2K byte block of EEPROM, and would be accessible only from the program that originally stored it.

Even if you could pass data from program to program in the BS2-SX, you would still have to take into consideration the limited number of writes available in EEPROM, as well as the potential effect on program execution when accessing program memory EEPROM. The short of it is that these problems are avoided with the introduction of scratch pad RAM.

Finally, the third improvement is speed. This baby is 2.5X faster than its predecessor, the BS2.

#### **New Commands**

Previously, I touched on the three new commands that are related to the new program memory allocation in the BS2-SX. Here we'll talk about them in greater detail.

As a refresher, the GET and PUT commands are

used to retrieve and store data in the scratch pad RAM. The RUN command is used to execute any of the programs residing in the BS2-SX program memory. Program 0 is always accessed on power up or after a reset. Additionally, the scratch pad RAM is always initialized to zero on power up or after a reset. The GET command takes the form ...

GET location, variable

where location is the memory location 0-63 that you want to

read from. This may be a variable or constant. Scratch pad RAM location 63 is a read only byte which tells the "reader" which program (0-7) is currently active. The variable defined for the GET command is the variable in which you wish to store the value from the scratch pad RAM. An example of using the GET command to read scratch pad RAM address 5, and store it in a variable named Stuff would be ...

Stuff	var	byte
GET DEBUG	5,Stur "Stuff = ",DEC	
END		

The PUT command is used to write data to scratch pad RAM. The PUT command takes the form ...

PUT location, value

where location is the memory location 0-62 that you want to write to. This may be a variable or constant. The value specified in the PUT command must be a byte-sized value (0-255), and may be a constant or variable. An example of using the PUT command to write the contents of a variable register called Stuff to scratch pad address 6 would be ...

Stuff	var	byte
PUT	6,Stuff	

Using a "location" value greater than the specified 0-63 for either the GET or PUT command will cause a rollover (or wrap) internal to the BS2-SX. In other words, a location of 64 will access scratch pad RAM location 0.

The RUN command is used to switch between any of the eight different program blocks which may reside in the BS2-SX. Program 0 is always accessed on power up. It is important to note that you can only access the beginning of any individual program stored in the BS2-SX program memory. While this precludes program jumps similar to those implemented by GOSUB commands, you can store condition values in scratch pad RAM. Condition values can be used to direct a newly accessed program to specific subroutines within that program. So, with a little house-keeping, the non-contiguous nature of the BS2-SX program memory is not a major roadblock. In Listing 1, the PUT, GET, and RUN commands are used to create a conditional jump.

#### **Old Commands That Have Changed**

All of the original 36 commands residing in the BS2 have been incorporated into the BS2-SX. While all of these commands function in the same manner, 11 of the commands do exhibit timing differences due to

Command	Change
COUNT	Period variable/constant is now in time units of 0.4ms
DTMFOUT	Ontime-Offtime variable/constant is now in time units of 0.4ms
FREQOUT	Duration variable/constant is now in time units of 0.4ms
	Freq1,2 variable/constant is now in frequency units of 2.5Hz
PULSIN	Result variable is now loaded with time units of 0.8us
PULSOUT	Time variable is now in time units of 0.8us
PWM	Cycles variable/constant is now in time units of 0.4ms
RCTIME	Result variable is now loaded with time units of 0.8us
SERIN	bit period = INT(2,500,000/Baud Rate)-20 - see Figure 3.
SEROUT	bit period = INT(2,500,000/Baud Rate)-20 - see Figure 3.
SHIFTIN	data is clocked in at 42KHz
SHIFTOUT	data is clocked out at 42KHz
Figure 2: Mod	difications Exhibited by BS2-SX in BS2 Commands

Baud Rate	8N1 inverted	7E1 inverted	8N1	7E1
600	20530	28722	4146	12338
1200	18447	26639	2063	10255
2400	17405	25597	1021	9213
4800	16884	25076	500	8692
9600	16624	24816	240	8432
19200	16494	24686	110	8302
38400	16429	24621	45	8237



Write in 34 on Reader Service Card.





OEM (R) PRICE, EVAL (I) 995
INCLUDES:
-3 SERIAL, PARALLEL (22bif)
-UP TO 4MEG ROM (27C546)
-BUILT-IN RAM & EEPROM
-MEM EXPANDABLE TO 640K
-REAL TIME CLE/INTERRUPT
-LCD AND KEYBOARD PORTS
-ON-BOARD LED DISPLAY
-STANDABD PC ISA BUS
-STANDABD PC ISA BUS
-STANDABD PC ISA BUS
-STANDABD PC ISA BUS

Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS. Use Turbo C, BASIC, MASM, All utilities to do this included. 386 versions available starting at \$55. Learn embedded technology!

#### UNIVERSAL PROGRAMMER

\$95 PRICE

EEPROM, UVEPROM, FLASH, NVRAM. DOES UP TO 8 MEG 27080). ADAPTERS FOR MICROS, PLCC, OTHERS. PARALLEL PORT VERSION.



## SINGLE CHIP SALES COMPUTER \$1.99

BUILT-IN BASIC!!!

20MIPS-16BIT-10X FASTER THAN 16c54
2K FLASH-64 EE -REPROGRAMMABLE
ZERO EXTERNAL COMPONENTS
32 MATHREGS-ANALOG COMPARATOR
15 JO (6 SERIAL 8 PARALLEL, LANALOG)
RS32 DOWNLOAD -NO DEVKIT NEEDED
3 IRQ-RTC-2.7TO 7VOLT OPERATION

RES VX RACE PROTECTION OF THE PROTECTION OF THE



\$21 PC SOLID STATE DISK OEM (III) EVAL 75.00 FLASH/RAM/EPROM

PC WATCHDOG!
REBOOTS PC 1K S21 1 595







web site: www.mvsweb.com

MVS BOX 850
MERR.NH 03054
(508)792-9507
MVS Sy limited warra
free Shipping
hrs: Mon-Fri 10

#### STAMP APPLICATIONS

8N1 is defined as 8

data bits, no parity,

and 1 stop bit; 7E1

is similarly defined

as 7 data bits, even

parity, and 1 stop

bit. Inverted data is

data defined by a

- Provide the second se		
'Program 0		
Condition var	byte	'Define condition variable
Condition = 1 if IN15 = 1 then No_Char Condition = 0 No_Change:	nge	'Condition defaults to 1 'P15 state determines Condition 'If P15 is low then Condition is 0
PUT RUN END	O,Condition 1	'Store condition in scratch pad RAN 'Execute program 1
'Program 1		
Point var	byte	'Program LED state
GET if Point = 0 then HIGH GOTO LED_off	O,Point LED_off 14 Done	'Retrieve Condition variable 'Test condition 'Light LED
LOW Done:	14	'Extinguish LED
RUN END	0	'Execute program O
Listing 1		

the change in operating speeds between the BS2 and the speedy BS2-SX. These changes are listed in an abbreviated form in Figure 2.

For most BS2 users, these changes will only create minor modifications in old BS2 code when porting it over to the new BS2-SX. Of course, if you've got code running on a BS2, and it's doing the job, there is no reason for a conversion. Histed these changes simply to give someone familiar with the BS2 some insight into differences they might expect when using the BS2-SX for the first time.

logic high start bit.

#### **Code Example**

While developing these code fragments, I made use of the Parallax BASIC Stamp Win Interface v1.091. This is a beta version of a Windows 95/98/NT 4.0 interface with many features. This, and older programming software (such as DOS versions), can be downloaded from the Parallax web site at no charge (www.parallaxinc.com).

This beta software did not appear to be too I seem to find myself making use buggy, although the programs I was working the Stamp's with were extremely short. Since this was my first attempt at using the BS2-SX with the Windows interface that Parallax provides, I felt it SERIN and SEROUT commands more often than any other was best to keep things short and sweet. instruction. My BS2-SX was connected to the PC via a I'm assuming that that Parallax Board of Eduction for this software test. may be true of a lot but any interface hardware that works with a of other Stamp BS2 should work with a BS2-SX. users as well. For I wrote three programs which made use of the GET, PUT, and RUN commands to blink a that reason, I've included the couple of LEDs. The rate of the blinking was based on a variable that was loaded by programs SERIN/SEROUT baud rate conver-1 and 2. This variable was modified by program sions in Figure 3; 0, which caused the rate of blinking to cycle

from fast to slow. I couldn't find any well-documented examples of loading multiple programs into the BS2-SX with the Windows Interface software. But from the READ.ME file, and through trial and error, I was able to get all three programs to load whenever I loaded program 0.

Over the next few weeks, I'll be contacting Parallax to get the low-down on this process, check for updated documentation, and see if any new information is available. I'll be sure to include whatever information, or corrections, I receive in the next Stamp Applications article.

The trick to linking all of your programs appears to be through the use of the {\$STAMP BS2SX) directive. This directive takes the form

{\$STAMP BS2SX,file1,file2,...,file7}

where each file is the actual path and file name

## RF Data Modules



#### AM TRANSMITTER

- •Small size: 17.78 x 11.43mm •CMOS/TTL input
- No adjustable components
- Low Current, 4mA typical.
- •418MHz or 433.92MHz OOK
- Simple to integrate -simply add antenna, data and power
- Range up to 250ft.
- •Wide supply range, 2-14Vdc ·SAW controlled - stability
- · Also available in DIL package



#### AM RECEIVER

- •Compact size: 38.1 x 13.7mm
- On-board data recovery. CMOS ·Low current. 2.4mA typical
- •2kHz data rate. CMOS/TTL output
- •5Vdc operation •On 418MHz or 433.92MHz (4xx)
- No adjustable components
   Patented Laser Trimmed component
- High stability
   Sensitivity: -105dBm
- · Available also in 0.8mA version

AM-HRR3-4xx ..... \$10.95



#### FM TRANSCEIVER

- Only 23 x 33 x 11mm
- •Up to 40k bps data rate
- •19200 baud with ASCII •Up to 500ft, range
- •5v operation
- •0.25mW into 50 •418 or 433MHz FM
- · Fast 1ms enable
- Direct interface to 5V CMOS
- Auto TX/RX changeover

BIM-4xx-F ..... \$87.36

#### RS232 TRANSCEIVER MODULES



- \*4,800 to 38,400 bps half duplex •3-wire RS232 interface
- •u Controller with user EEPROM
- RS232 interface protected to ±15kV Data packetizing performed by user
   Auto TX/RX changeover
- •418 MHz and 433MHz versions •Range up to 500ft. (0.25mW ver.)
- •0.25mW & 10mW version Reset switch and status LED's
- •7.5-15V dc via DB9 connector, 20mA

BIM-4xx-RS232 .... \$139.30



•Up to 19,200 bps half duplex 3 wire RS232 interface Range up to 500ft

Transparent data packetizing Supports 8 or 9 bit protocols Self test function • Reset Switch & Staus LED's

•1/4 wave wire antenna on board · Available in a Simplex Tx/Rx pair.(RTcomTX & RTcomRx)

•7.5V-15Vdc operation .. \$247.90 RTcom-4xx... Transceiver. RTcomTx-4xx. Transmitter RTcomRx-4xx... \$105.52 Receiver.



Tel: (416)236-3858 Fax: (416)236-8866 www.abacom-tech.com abacomtech@compuserve.com





## JUST ABOUT EVERYTHING YOU NEED FOR FAXES & PRINTERS IS AT ONE CONVENIENT ADDRESS:

## www.faxrepair.com

#### For service, parts & sales, Cyber-Test is America's Largest Fax Support Center.

- . CIRCUIT BOARD REPAIR Component level repair on boards and power supplies for all brands & all models.
- ENTIRE MACHINE REPAIR We fix any thermal, ink jet or laser fax. Low flat rates available!
- PARTS We have a huge inventory of new & refurbished fax and printer parts ready to ship. Easy ordering with no part number necessary. H-P laser parts available!
- SALES Great deals on commercial grade plain paper faxes.
- SUPPLIES Drums, toner & developer for laser faxes or printers. Lowest prices anywhere for Okidata, AT&T, DEX and Samsung!
- SUPPORT Why go anywhere else? Check our Web Site or call today!



press "6" for repair & sales

448 Commerce Way - Bldg. 100 - Longwood, FL 32750

#### STAMP APPLICATIONS

'******************* 'Program 0 - bsx_prg0.b		*******			
'{\$STAMP BS2SX,C:\Parallax\bsx_prg1.bsx,C:\Parallax\bsx_prg2.bsx} 'O:bsx_prg0.bsx					
Timer var	byte	'Define constants/variables			
PUT RUN END	O,Timer = Timer + 10 = ",DEC Timer,CR O,Timer 1	'Get old Timer 'Modify Timer 'Display Timer 'Store new Timer 'Execute program 1			
'Program 1 - bsx_prg1.b Grn_LED Red_LED Timer	**************************************	'Define constants/variables			
GET LOW LOW PAUSE Timer RUN END	O,Timer Red_LED Grn_LED	'Get Timer 'Turn off LEDs 'Pause 'Execute program 2			
'Program 2 - bsx_prg2.b: Grn_LED Red_LED Timer	**************************************	'Define constants/variables			
GET HIGH HIGH PAUSE Timer RUN END	O,Timer Red_LED Grn_LED	'Get Timer 'Turn on LEDs 'Pause 'Execute program 0			
'*************************************					

that belongs to your BS2-SX project. My programs were all stored in the C:\Parallax directory. If your files are stored elsewhere, you will want to select the correct path for your directory structure.

You will also wish to set the software up to communicate with a BS2-SX. This can be done through the EDIT®PREFERENCES®EDITOR OPERATION menus. Just select the correct communication port and ensure the BS2-SX is selected. After doing this, you can use the CTRL+I shortcut to identify the Stamp version you are connected to. If there is a communication problem between your PC and the Stamp, it will show up here.

Each of the three programs are listed together, but I think it is important to point out that each program was actually written in a separate editor window of Parallax's Win Interface software. The software makes it easy to switch between editing windows. I believe that this method of writing software for the BS2-SX will actually help with program organization. This is especially true of Stamp users who have not written code extensively for other microcontrollers

closer to the performance available in application specific microcontrollers. While the performance of the BS2-SX still does not match that of a custom-designed microcontroller, its ease of use is unmatched. Also, on the plus side, the addition of the faster BS2-SX, with a much larger memory map, has not resulted in a steep learning curve.

RESOURCES

For more information on the

BASIC Stamp, contact:

Parallax, Inc.

3805 Atherton Road, #102

Rocklin, CA 95765

phone (916) 624-8333

http://www.parallaxinc.com

**Scott Edwards** 

Electronics, Inc.

1939 S. Frontage Rd. Ste. F

Sierra Vista, AZ 85635

phone 520-459-4802

fax 520-459-0623

www.seetron.com info@seetron.com

**Solutions Cubed** 

Lon Glazner

3029 Esplanade Suite F

Chico, CA 95973

E-Mail: lon@solutions-cubed.com www.solutions-cubed.com

Phone: 530-891-8045

Fax: 530-891-1643

In fact, the greatest trouble I had resulted in the minimal documentation available for the Windows interface software. And I'm sure Parallax is working on this aspect of their "design

Function Generator

**Pulse Generator** 

All in all, the BS2-SX appears to be a fine addition to the BASIC Stamp product line. Next month, we'll go into more depth and learn how to use the multiple program capability of the BS2-SX to develop a versatile communication interface. Hope you can make it! NV

Ramps, Triangles, Exponentials, Noise & more.

Digital waveforms with adjustable duty cycle

0 to 2 MHz in 1 Hz steps. Continuous or Triggered.

#### (which can get quite large).

Synthesized Signal Generator

Clean sinewaves DC-21.5 MHz with .001% accuracy!

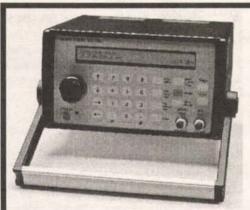
40 Megasamples/Second. 32,768 points. 12 bit DAC

.01 Hz steps. DC Offset. RS232 remote control.

**Arbitrary Waveform Generator** 

#### In Closing

The two major shortcomings of the BS2 were limited program storage space, and slow instruction execution speed. Both of these shortcomings have been addressed with the release of the BS2-SX. The BS2-SX creeps



Telulex Inc. model SG-100A

✓ 21.5 MHz

New Features: 
multi-unit

Telulex Inc.

✓ .01 Hz steps phaselock

and log sweeps

DC to 21.5 MHz linear

Pulse Generator



v waveform

Int/Ext AM, SSB, Dualtone Gen.

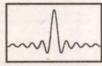


Noise

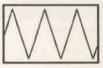
Fax (650) 938-0241



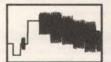
Int/Ext FM, PM, BPSK, Burst



**Arbitrary Waveforms** 



Ramps, Triangles, Exponentials

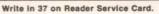


Unlimited Possibilities!

Tel (650) 938-0240

http://www.Telulex.com Email: sales@Telulex.com

2455 Old Middlefield Way S Mountain View, CA 94043



## vents

#### OCTOBER 1999

#### OCTOBER 1

WI - RACINE - Auction, Racine Megacycle Club, Dennis Doonan W9DAD, 414-552-6RMC. E-Mail: w9dad@arrl.net Web: http://www2.wi.net/-hamradio/auction.html

#### OCTOBER 1-2

AR - SPRINGDALE - Hamfest, Northwest AR ARC, Clarence Morrow KC5UEW, 501-631-9231

#### OCTOBER 1-2-3

CA - LONG BEACH - ARRL Southwestern Division Convention. Nate Brightman K6OSC, 562-427-5123.

Web: http://www.qsl.net/arrlsw/hamcon/

#### OCTOBER 2

AK - FAIRBANKS - Hamfest. Arctic ARC, Fred Brown KL7CUS, 907-452-3452. E-Mail: fbrown@mosquitonet.com. Jim Movius KL7EGO, 907-452-6347. E-Mail: ajmovius@gci.net Web: http://www.aarc.uaf.edu

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet, Santee Drive-in. 619-561-0052

FL - MAITLAND - Hamfest. Bahia Shrine AR Unit, Cecil Morehouse K4KEN, 407-281-9169 MO - WARRENSBURG - Hamfest. Warrensburg Area ARC, Keith Haye WEOG, 816-697-3426. E-Mail: weOg@microlink.net

NJ - LEONARDO - Hamfest '99. Croydon Hall, Leonardville Rd. east of Hosford Ave. 8am. VE Exams. Talk-in: 145.485 (-). Middletown Township OEM & Garden State ARA, Mario Sellitti N2PVP, 732-787-7184. E-Mail: gsara@monmouth.com

Ny-syraCuse - Hamfest. Pompey Hills Fire Dept., off Rt. 20. 8am-2pm. Talk-in: 147.90/30. RAGS, Vivian Douglas WA2PUU, 315-469-0590. E-Mail: ragsonline@hotmail.com

Web: www.pagesz.net/-rags
PA - LEWISBURG - Computer, Amateur Radio & Electronics Show & Flea Market, Silver Moon Antique & Flea Market Show Area, Rt. 15, 2.3 mi N of Rt. 45. 9am-4pm. Talk-in: 147.270 Repeater & 146.52 simplex. Susquehanna Valley ARC, George Machesic 570-286-2086. E-Mail: gpmac@netscape.net, Dave Welker k3si@hot mail.com Web: http://loveland.dynip.com/svarc
SC - ROCK HILL - Hamfest. York County ARS,
Haney Howell K2XN, 803-323-4534.
Web: http://www.ycars.org
TX - BELTON - Hamfest. Bell County Expo

Center. Temple ARC, Mike LeFan WA5EQQ, 254-773-3590. E-Mail: hamexpo@tarc.org Web: www.tarc.org

#### OCTOBER 3

IA - WEST LIBERTY - Hamfest, lowa City & Muscatine ARCs, Bruce Dagel WB0GAG, E-Mail: wb0gag@excite.com Web: http://www.netins.ne t/showcase/mrc/pictures/hamfl.ip IN - BEDFORD - Hamfest. Hoosier Hills Ham Club, Keith Harris N9KH, 812-275-3415. Web: http://dmrtc.net/-jscheiwe/hamfest.html
NY - QUEENS - Hamfest. Hall of Science parking

lot, Flushing Meadow Park Corona, 47-01 111th St. 9am-3pm. Talk-in: 444.200 repeat, PL 136.5, 146.52 simplex. Hall of Science ARC, Stephen Greenbaum WB2KDG, 718-898-5599. E-Mail: WB2KDG@Bigfoot.com

PA - WRIGHTSTOWN - Hamfest. Middletown Grange Fairgrounds, Penns Park Rd. Talk-in: 146.52 simplex. Mt. Airy VHF RC, Mark Schreiner NK8Q, 610-847-2285, E-Mail: nk8q@arnsat.org. Bob Minch N3XEM, 215-822-0779 E-Mail: raminch@bellatlantic.net Web: http://www.ij.net/packrats/l

#### OCTOBER 8-9

FL - STARKE - Hamfest. Bradford County Fairgrounds, US 301 N. Fri: 2pm-8pm, Sat: 8am-4pm. Talk-in: 145.150-. Bradford Area ARC, Walt Terrell 904-755-4964 or Tony Spatafore 904-964-9328. E-Mail: wb2fgl@techcomm.net Web: www.angelfire.com/fl/arcba/index.html

web: www.angenne.com/n/arcoa/index.ntmi
NH - ROCHESTER - Hamfest. Fairgrounds. Hoss
Traders, Joe Demaso K1RQG, 207-469-3492.
E-Mail: k1rqg@aol.com
Web: http://www.qsl.net/k1rqg/

#### **OCTOBER 8-9-10**

CA - BAKERSFIELD - Hamfest. Bakersfield ARA, Robert Gerner Jr. KB6JFL, 661-588-7065. E-Mail: w6bar@hotmail.com Web: http://members.tripod.com/-w6bar/bara.html

#### OCTOBER 8-9-10-11

CA - SAN DIEGO - 17th Space Symposium & AMSAT-NA Meeting. Duane Naugle KO6BT, 619-273-4088. E-Mail: ko6bt@amsat.org

he Events Calendar is a free service for publicizing electronic events such as amateur radio hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days in advance Include your flyer, estimated attendance, name of the person to contact, and phone number

Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

While we strive for accuracy in our calendar, we can not be responsible for errors or cancellations. The information contained in this column is for the use of the readers of Nuts & Volts and may not be republished in any form without the written permission of T & L Publications, Inc.

All listing information should be sent to:

**Nuts & Volts Magazine Events Calendar** 

430 Princeland Court Corona, CA 91719

Phone 909-371-8497 Fax 909-371-3052

E-mail events@nutsvolts.com

Web: http://www.amsat.org

#### OCTOBER 9

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

GA - AUGUSTA - Hamfest. Westside High School, 1002 Patriots Way. 9am-3pm. Talk-in 145.490-. ARC of Augusta, Terry Brown KE4MHN, 706-796-1128. E-Mail: cookie4u@cheerful.com Henry Arostegui KN4AV, 706-793-1625, E-Mail: kn4av@bellsouth.net. E-Mail: w4dv@hotmail.com, or w4dv@arrl.net Web:

http://www.gabn.net/kd4ahqweather/arca.html NJ - TEANECK - Hamfest. Bergen ARA, Jim Joyce K2ZO, 201-664-6725. E-Mail:

jjjoyce@cybernex.net Web: http://www.bara.org WA - BREMERTON - Hamfest. President's Hall, WA - BREMENTON - Hamlest, President's Hall, Kitsap County Fairgrounds, License Exams 10am, Talk-in: WW7RA repeater 146.620-, tone 103.5, simplex 146.520. North Kitsap ARC, Marcie Stilwell, 360-697-2797. E-Mail: nkarc@yahoo.com Web: http://www.silverlink.net/nkarc

#### OCTOBER 9-10

FL - TAMPA - Hamfest, 4050 Dana Shore Dr. Sat & Sun 9am-3pm. Egypt Temple ARA, George Dixon 813-933-4350; Len Smith 813-684-4408; Larry Padgett 813-948-6500, E-Mail: kf4iti@ij.net

#### OCTOBER 10

CT - WALLINGFORD - Connecticut State ARRL Convention. Mountainside Special Event Facility, High Hill Rd. 9am-3pm. Nutmeg CT Conv. Nutmeg Hamfest Alliance, Gordon Barker K1BIY, 860-342-3258 E-Mail: k1biy@juno.com. E-Mail: nutmeghamfest@qsl.net Web: http://www.qsl.net/nutmeghamfest

IL - OAK BROOK TERRACE - Hamfest. Chicago ARC, George Sopocko WA9JEZ, 773-545-3622 MD - WEST FRIENDSHIP - CARA Hamfest. Howard County Fairgrounds, S of I-70, E of Rt. 32. 8am-3:30pm, VE Exams, Talk-in: 147.135 (-) repeater, 146.52 simplex, CARA, 410-796-2587

Web: http://www.ocbs-nt-server.umaryland.edu/cara/hamfest.htm MI - MASON - Hamfest. Ingham County
Fairgrounds. 8am-2pm. Talk-in: 145.390-. Central
MI ARC & Lansing Civil Defense Repeater Assn.,
Don Tillitson WB8NUS, 517-321-2004. Web: http://www.qsl.net/cmarc/hamfair-html NC - MAYSVILLE - Hamfest. Jo Ann Taylor WD4JYR, 252-393-2120
OH - LIMA - Hamfest, Northwest OH ARC, Greg

Schwark N8WBD, 419-647-6321. E-Mail: gas1950@aol.com

#### OCTOBER 15-16

MS - BILOXI - Hamfest, MS Coast ARA, Wayne Miller KB5AAU, 228-539-9929. E-Mail: kb5aau@worldnet.att.net Web: http://www.ametro.net/mcara

#### OCTOBER 15-16-17

CA - CONCORD - Pacific Div. Convention. Mt. Diablo ARC, Dick Brown KT6X, 925-676-9048. E-Mail: paccon99@pacbell.net Web: http://www.pacificon.org

#### OCTOBER 16

AZ - TÜCSON - Hamfest. OPRC/ARCA, Glenn Henderson WA7OBG, 520-749-5478. E-Mail: linus@primenet.com Web: http://www.hamsrus.com
CA - SANTEE - ARC of El Cajon Ham, Computer

& Electronic Swapmeet. Santee Drive-in. 619-561-0052

IL - GODFREY - Hamfest. Community College, River Bend Arena. VE testing. Talk-in: 145.230, 442.225. Lewis & Clark RC, Harold Elmore N9HE,

#### COMPUTER SHOWS

AGI Shows, 317-299-8827. E-Mail: info@agishows.com http://www.agishows.com

**Blue Star Productions** 612-788-1901 http://www.supercomputersale.com

Computers And You, 734-283-1754. w.a1-supercomputersales.com

Computer Central Shows 847-412-1900 & 1-888-296-6066. E-Mail: compcent@megsinet.net www.computercentralshows.com

Five Star Productions 810-379-3333. E-Mail: jeff@fivestar www.fivestarshows.com

Georgia Mountain Productions 706-838-4827. E-Mail: gamtnpro@blrg.tds.net georgiamountain.com

Gibraltar Trade Center, Inc. 734-287-2000. Taylor, Ml. E-Mail: taylor@gibraltartrade.com www.gibraltartrade.com

618-466-1909, E-Mail: n9whh@ezl.com Web: http://www.ezl.com/~lmiller/lcrc.html

MT - BOZEMAN - Hamfest, Gallatin Ham Radio Club, Laura Marino Lubner KJ7UN, 406-586-6659. E-Mail: ghrc@bigfoot.com Web: http://ghrc.webjump.com

TN - GRAY - Hamfest. Appalachian Fairgrounds, off I-181. Kingsport, Bristol, and Johnson City Radio Clubs, Wendell Messimer K4ZHK, 423-928-4407. E-Mail: messimerw@ten-nash.ten.k12.tn.us Web: http://home.naxs.com/jcara
TX - DENTON - Hamfest. Denton County ARA,

Don Mathis KB5YAM, 972-292-1203. E-Mail: dmathis@lsic.net. Web: http://lsic.net/dhf UT - CEDAR CITY - Color Country Hamfest. Russ Roberts K7USN, 435-865-7822

UT - CEDAR CITY - Hamfest. Rainbow Canyons ARC, Jerry Renna KB7BCL, 435-865-0908. E-Mail: renna@netutah.com

#### OCTOBER 16-17

FL - PALM BEACH GARDENS - Hamfest. AMARA Shrine Temple, 3650 RCA Blvd. Sat: 9am-4pm, Sun: 9am-2pm. Talk-in: 147.165/147.765. Palm Beach Repeater Assn., Ken Summerell KD4CTG, 561-640-9447. E-Mail: sum@flinet.com

#### OCTOBER 17 MA - CAMBRIDGE - Flea at MIT. Albany and

Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html MI - KALAMAZOO - Hamfest. County Fairgrounds. Talk-in: 147.040 K8KZO. Kalamazoo ARC & SW MI AR Team, Charles Burgstahler KA8BLO, E-Mail: ka8blo@net-link.net Web: http://www.qsl.net/ka8blo/hamfest.html OH - ASHLAND - Hamfest. County Fairgrounds, Claremont Ave. 8am-2pm. Talk-in: 147.105+, 71.9PL. Ashland Area ARC, David Fike N8UCA, 419-289-1082, daytime. Mike Stroub KC8LCH, 419-945-2777, nighttime.

#### Gibraltar Trade Center, Inc. 810-465-6440. Mt. Clemens, MI. E-Mail: mtclemens@gibraltartrade.com www.gibraltartrade.com

**KGP Productions** 

1-800-631-0062, 732-297-2526. E-Mail: kgp@mail.com

MarketPro, Inc., 201-825-2229. http://www.marketpro.com

MarketPro, Inc., 301-984-0880. E-Mail: md@marketpro.com http://marketpro.com

Narisaam Computer Show 770-663-0983.

E-Mail: narisaam@aol.com Web: http://www.shownsale.com

Northern Computer Shows 978-744-8440. E-Mail: inquiries@ncshows.com

Web: ncshows.com

Peter Trapp Computer Shows 603-272-5008. Web: www.petertrapp.com

E-Mail: aaarc@hotmail.com
PA - SELLERSVILLE - Hamfest. NEW Sellersville

Fire House, Main St. Bethlehem Pike. 7am-1pm. VE Exams. Talk-in: 145.31 (144.71 input) W3AI ve Exams. Taik-in: 149.31 (144.71 Input) w3Ai repeater. R. F. Hill ARC, Linda Erdman KA3TJZ, 215-679-5764. Web: http://www.rfhill.ampr.org WA - CHEHALIS - Hamfest. The Southwest Washington Fairgrounds. Talk-in: 147.06+ 110.9 pl, simplex 146.46. Chehalis Valley ARS, Jim Kruger KK7AB, 360-748-1930; KK7AB@ARRL.net or Bill Harwell KC7QHJ, 360-748-8086. E-Mail: bharwell@localaccess.com Web: http://www2.localaccess.com/teaser/cvars/

#### OCTOBER 23

LA - LAKE CHARLES - Hamfest. Southwest LA ARC, Dick Rogers WB5TUG, 318-474-7947. E-Mail: hotred@linknet.net

NH - NASHUA - Hamfest. Res Ctr Church, Antique RC, 617-923-2665

OK - ALTUS - Hamfest. Altus Area ARA, Mike Schenkel W5VXU, 580-846-5578. E-Mail: w5vxu@juno.com

OR - RICKREALL - Swap-Toberfest, Polk County Fairgrounds, 9am-3:30pm, Talk-in; 146.86-, Mid-Valley ARES, Bob Boswell, W7LOU 503-623-2513, E-Mail: w7lou@goldcom.com Web: http://www.teleport.com/~n7ifj/swaptobe.htm

TN - CHATTANOOGA - Hamfest. C. Jordan in E. Ridge. Chattanooga ARC, David Hoffman KE4FGW, 423-877-7398. E-Mail: w4am@qsl.net Web: http://www.qsl.net/w4am

#### OCTOBER 24

IN - LEBANON - Hamfest. Boone County Fairgrounds. 8am-1pm. VE testing. Boone & Clinton County ARC, Sara Lecklitner KB9OEZ, 765-482-9152

MD - WESTMINSTER - Mason-Dixon Computer & Hamfest. Carroll County Ag Center, 8am. VE Exams. Talk-in: 145.410 CCARC Repeater, Carroll County ARC, Wayne Wilson N3UN, 410-795-2556 (ph/fax). E-Mail: k3pzn@qis.net. Web: http://www.gis-net/-k3pzn

## nears CALENDAR

MI - WARREN - Hamfest, Utica Shelby Emergency Comm. Assn. Debbi Cokewell KB8YYB, 810-263-0227. E-Mail: cuer@juno.com Web: http://www.useca.org
NY - LINDENHURST - Hamfest. Great South Bay

ARC, Tom Carrubba KA2D, 516-422-9594. E-Mail: info@gsbarc.org Web: http://www.gsbarc.org PA - GREENSBURG - Hamfest. 8am-2pm. Talk-in: 147.180+. Foothills ARC, Jim Yex WB3CQA, 724-864-6228. E-Mail: jpyex@sgi.net Web: http://www.geocities.com/Heartland/Acres/7896/

#### OCTOBER 29-30

FL - JACKSONVILLE - Greater Jacksonville Amateur Radio & Computer Show. Morocco Shrine Auditorium, 3800 South St., Johns Bluff Rd. Fri: 1-8pm, Sat: 9am-5pm. VE Exams. Greater Jacksonville Hamfest, Woody Parker KF4GSK, 904-743-3121. E-Mail: sbarber@mediaone.net. Web: http://www.ccse.net/-lrich/hamfest98.htm OK - KINGSTON - Hamfest, Texoma Hamarama.

Herb Sleeper WB5PHM, 940-855-5820. F-Mail: retmarine@cst.net

Web: http://www.qsl.net/kc5sig/hamarama

#### OCTOBER 30

CT - WATERFORD - Auction. Tri-City ARC, Austin Wolfe AA1SV, 860-443-2459 E-Mail: aa1sv@downcity.net

MN - ST. PAGL - Hamfest. The New RiverCentre. 8am-4pm. VE Exams. Twin City FM Club, Dale Reak KB0VCV, 612-687-9535. Web: http://www.hamfestmn.org

#### OCTOBER 31

IA - DES MOINES - Hamfest. Tikva Tracer ARC, Randall Lees NOLMS, 515-279-4241. E-Mail: hamfestiowa@juno.com Web: http://www.bestofiowa.com/hamfestiowa/

MO - ST. LOUIS - Hamfest. St. Louis ARC & Gateway to Ham Radio Club, Steve Welton WBOIUN, 314-638-4959. E-Mail: slw@partyline.net OH - MARION - Hamfest. Marion ARC, Karen Eckard N8KE, 740-499-3565.

E-Mail: meeker@gte.net OH - MASSILLON - Hamfest. Stark County Fairgrounds. Talk-in: 147.18+ & 442.85. Massillon ARC, Don Wade W8DEA, 330-497-7232. E-Mail: marc.hamclub@iuno.com

#### **NOVEMBER 1999**

#### NOVEMBER 6

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

FL - SORRENTO - Hamfest. East Lake Chamber of Commerce Bldg, VE Exams. Talk-in: 147.255. Lake ARA, John Wentz W8HFK, 352-728-2615. E-Mail: caplas@gate.com Chuck Crittenden KE4EXM, 352-669-2075 IL - BELLEVILLE - Hamfest. Belleville Area

College, Carlyle Rd. (Rt. 161) & Green Mount Rd., Main Campus. 8am-2pm. VE testing, Talk-in: 147.120 K9GXU repeater. Scott Composite ARS, Howard "Skip" Mize KA9VKE, 618-277-9767. E-Mail: fluinc@peaknet.net

IN - FORT WAYNE - Hamfest & State Conv. Allen County War Memorial Coliseum Expo Center. Sat: 9am-4pm, Sun: 9am-3pm. Talk-in: 146.88-. ACARTS, 219-484-1314.

Web: http://www.pipeline.com/~dagagnon/ KY - HAZARD - Hamfest. Kentucky Mountains ARC, John Farler K4AVX, 606-436-5354. E-Mail: jfarler@mis.net Web: http://www.geocities.com/S iliconValley/2564/kmarc.ht NH - MANCHESTER - Hamfest. St. John Church.

305 Kelley St. Talk-in: 146.850 PL 85.4. Paul K1LLX 603-432-1538.

E-Mail: K1LLX@juno.com

OK - ENID - Hamfest. Enid Hamfest Group, Tom Worth N5LWT, 580-233-8473.

E-Mail: n5lwt@hotmail.com

SC - MYRTLE BEACH - Beachfest '99, Old Myrtle Beach Air Force Base. 7am-2pm. Talk-in: 147.120 +600. Grand Strand ARC, Jim Wood KF4CJE, 843-238-0800. E-Mail: kf4cje@juno.com Web: http://www.w4gs.org
WI - MILWAUKEE - Hamfest. Milwaukee Repeater

Club, Mike Borchardt N9NPB, 414-367-3953. Web: http://execpc.com/~mrc/friendlyfest.htm

#### NOVEMBER 6-7

GA - LAWRENCEVILLE - Hamfest, Gwinnett County Fairgrounds, Talk-in: 145.45- (PL 107.2), 444.25+ (PL131.8), 146.76- (PL 107.2). Alford Memorial RC, Hotline: 770-410-3989. E-Mail: hamfest@totrbbs.radio.org
TX - ODESSA - Hamfest. West Texas ARC, Robert Jordan N5RKN, 915-335-7980. E-Mail: n5rkn@apex2000.net Web: http://www.wt5arc.org Web: http://nonprofit.apex2000.net/hamfest/

#### NOVEMBER 7

MI - ST. JOSEPH - Hamfest. Blossomland ARA, Duane Durflinger KX8D, 616-982-0404

E-Mail: comdac@comdac.com

Web: http://www.comdac.com/bara
NY - POUGHKEEPSIE - Hamfest. Mt. Beacon Ken Akasofu KL7JCQ, 914-485-9617. E-Mail: kl7icg@arrl.net

Web: http://www.mhv.net/-fritzing
PA - LINGLESTOWN - Hamfest. Linglestown Fire Hall. VE testing. Talk-in: 145.470 & 146.520 simplex. Central PA Repeater Assn., Harold Baer KE3TM, 717-566-8895
WI - KAUKAUNA - Hamfest, Starlight Club. VE

testing. Talk-in: 146.52 simplex. Fox Cities ARC, Chad Pennings N9PRC, 920-993-0485. E-Mail: n9prc@kb9byq.ampr.org Web: http://www.w9zl.ampr.org

AL - MONTGOMERY - State Convention. Garrett Coliseum, South AL State Fairgrounds, Federal Dr. 9am-3pm. FCC exams. Talk-in: 146.24/84, W4AP. Montgomery ARC, Phil Salley K4OZN, 334-272-7980 after 5pm CST. E-Mail: wb4ozn@worldnet.att.net

Web: http://jschool.troyst.edu/~w4ap/ CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High

School Bill 909-822-4138 eves NM - SOCORRO - Hamfest. Socorro ARA, Al Braun AC5BX, 505-835-3456.

E-Mail: ac5bx@juno.com Web: http://www.ees.nmt.edu/sara/homepage.html

NOVEMBER 13-14

IN - FORT WAYNE - IN State ARRL Convention & Hamfest. Allen County War Memorial Coliseum Expo Center. Sat: 9am-4pm, Sun: 9am-3pm. Talkin: 146.88. Allen County AR Technical Society, Doug Jones N9NNT, 219-484-1314; E-Mail: djones2233@aol.com, Jim Boyer KB9IH, 219-484-3317. Web: http://www.acarts.com

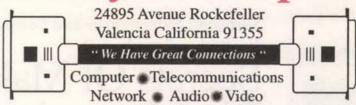
#### NOVEMBER 14

IL - PEORIA - Autonomous Sumo Robot Competition. 1pm. Central IL Robotics Club, Jim Munro. E-Mail: jimmn@xnet.com Web: http://circ.mtco.com/contest.htm

NY - FARMINGDALE - Hamfest. Radio Central ARC, Neil Heft KC2KY, 516-737-0019. E-Mail: nheft@ibm.net Web: http://www.li.net/~n2mda

NOVEMBER 19-20

## Roger's Systems Specialist



#### Category 5 Patch Cable

TE-038-L5	3ft. Straight Patch	\$175
TE-068-L5	7 ft. Straight Patch	\$200
TE-128-L5	14ft. Straight Patch	\$400
TE-258-L5	25ft. Staight Patch	\$500
TE-358-L5	35ftt. Straight Patch	\$700
TE-508-L5	50 ft. Straight Patch	\$1000
TE-758-L5	75ft. Straight Patch	\$1700
TE-108-L5	100 ft. Straight Patch	\$2000



#### KEYBOARD & MOUSE KB-449 Acer PS/2 Win. Keyboard \$800 TM-290-PS Acer PS/2 2-button 6pin din \$500



CC-USB-6	6ft. USB "A" to "A" M/M	\$500
CC-USB-AB6	6ft. USB "A" to "B" M/M	\$500
CC-USB-PP	6ft. USB to IEEE Printer Cable	\$2900
CC-USB-AB10	10ft.USB"A" to "B"M/M	\$600
CC-USB-AB15	15ft.USB "A" to "B"M/M	\$800
CC-USB-X10	10ft, USB Extension	\$600

USB (2) to 2x8 pin w/ Bracket

USB (2) to 2x5 pin w/ Bracket

USB x2 PCI Add on Card

USB-KB-104 USB 104-Key Kybrd Win98/PS2 \$2400 USB-MOUSE 3-Button USB Mouse 4200dpi

C-IT USB Cam w/ Software

50 Pin centronics pass through connector

Internal Fan, 50P Ribbon, 30watt Power Supply

Push button I.D. setting, On/Off switch

CC-USB-8

CC-USB-9

USB-PCI

USB-CAM

NT-TBT-10

NT-TBT-100

NT-TBT-200

NT-8460B

NT-TRT-3C905R

←3.5 IN.→

**USB** Accessories



\$1900

\$1200

\$6200

\$5500

\$1500

\$500

\$500

\$2700

\$120

\$690

**External SCSI Case** 

Network Cards

TM-CASE-HDS

10-Base 16Bit ISA Slot Card

3COM 3C905B-TX 10/100 PCI

INTEL Pro+ 10/100 Express

10/100 32-Bit PCI Slot

10-Base 32-Bit PCI Slot



cat. no.TM-177

ACER AMPLIFIED SPEAKER SET W/ CABLES & POWER SUPPLY

## Patch Panels

## 

		All Category 5 568
	PP- 64P-5	64 Port Cat5 Patch Panel
	PP-12P-5	12 Port Cat5 Patch Panel
	PP-48P-5	48 Port Cat5 Patch Panel
1050		Bit of the reservation

PP-24P-5 24 Port Cat5 Patch Panel

\$5900 at5 Patch Panel # SPECIAL # \$7900 \$4200 5 Patch Panel \$255°°

ategory 5 568B Wiring

#### \$20.00 min. order required

- Add \$4.50 shipping for prepaid orders
  - Prices subject to change without notice
- A All major credit cards accepted
- Special offers only vaild on items in stock
- California residents add tax
- Call for quanity discounts
  - No out of state checks accepted

661-295-5577 800-366-0579

Fax 661-295-877

## nears CALENDAR

MS - OCEAN SPRINGS - Hamfest, St. Martin Community Center. Fri: 5-9pm, Sat: 8am-2pm. VEC testing Sat: 11am. Talk-in: N5OS 145.11-. West Jackson County ARC, Phil Hunsberger W9NZ, 228-872-1499. Stan Hecker N5SP, 228-

#### NOVEMBER 20

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

CO - GOLDEN - Hamfest. Jefferson County Fairgrounds, 15200 W. 6th Ave. 8am-2pm. VE testing. Talk-in: 144.62/145.22. Rocky Mountain Radio League, Inc., Ron Rose NOMQJ, 303-985-8692. E-Mail: nOmqj@arrl.net Web: http://rmrl.hamradios.com

second floor, 460 Newtonville Ave. 11am-4pm. WARA/1200 RC, Eliot Mayer W1MJ, 617-484-1089. E-Mail: W1MJ@amsat.org Web: http://our world.compuserve.com/homepages/emayer/auct OH - GEORGETOWN - Hamfest. Grant ARC, Gordon Neal W8YGW, 513-379-1659.

E-Mail: wb8ygw@juno.com Web: http://www.qsl.net/~n1djs

#### NOVEMBER 20-21

FL - TAMPA - Suncoast Hamfest, FL State ARRL Convention. State Fairgrounds, Expo Hall. Florida Gulf Coast Amateur Radio Council, Jean Endicott KC4KZU, 727-525-5178, E-Mail: swaps@fgcarc.org Web: http://www.fgcarc.org

#### NOVEMBER 21

NC - BENSON - Hamfest. Johnston ARS, Doug ams KS4TI, E-Mail: ks4ti@nceye.net Web: http://www.jars.net

#### NOVEMBER 27

IN - EVANSVILLE - Hamfest, EARS, Neil Rapp WB9VPG, 812-479-5741.

E-Mail: earsham@aol.com

Web: http://members.aol.com/earsham NC - GREENSBORO - Hamfest. Greensboro Coliseum Special Events Center. GGH, 336-851-1676. Web: http://www.sabwc.com/gsohamfest

#### NOVEMBER 28

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813

NY - PATCHOGUE - Hamfest, Mid-Island ARC, Mike Grant N2OX, 516-736-9126. E-Mail: globalcm@erols.com Web:

IL - WHEATON - Hamfest. DuPage County Fairgrounds. GMRS of IL, Inc., 815-436-7090 or 630-393-3937

http://www.gsl.net/mid-islandarc/hamfest.html

#### DECEMBER 1999

#### DECEMBER 4

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

FL - OKEECHOBEE - Hamfest. Okeechobee ARC. Bill Gastle

E-Mail: wgastle@okeechobee.com

GA - CLAXTON - Hamfest. Claxton ARES, John Perkins W4HYU, 912-739-4589.

E-Mail: w4hyu@juno.com LA - MINDEN - Hamfest, Minden ARA, Lowell A. "Dusty" Collins KB5WFE, 318-371-0636.

E-Mail: dustyc@microgear.net Web: http://www.microgear.net/gwinford/mara.htm

#### DECEMBER 5

IN - GREENFIELD - Hamfest, Greenfield Central High School Pavilion, N. Broadway St. Talk-in: 145.330, 444.725. Hancock ARC, Tom Donaldson N9LFU 317-326-3168

E-Mail: tomd@freewwweb.com Web: http://www.iei.net/~n9hqo

#### DECEMBER 11

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves SC - UNION - Hamfest. Armory, Union County

#### DECEMBER 18

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-005

#### JANUARY 2000

#### JANGARY 8

IN - SOUTH BEND - Hamfest, Michiana Valley Hamfest Assn., Bob Denniston KA9WNR, 219-291-0252

WI - WAUKESHA - Hamfest. West Allis RAC, Phil Gural W9NAW, 414-425-3649.

#### JANGARY 15

MO - ST. JOSEPH - Hamfest. MO Valley & Ray-Clay ARCs, Kevin R. Phillips KCOAWM, 816-320-2129. E-Mail: KevinRPhillips@hotmail.com Web: http://www.kc.net/-oconnor

#### JANGARY 15-16

FL - SARASOTA - Hamfest. Sarasota ARA, William Eddie Martin KI4ZJ, 941-954-1869. E-Mail: ki4zj@msn.com Web: http://www.saraclub.org

#### JANUARY 16

MI - HAZEL PARK - Hamfest. High School, 23400 Hughes St. 8am-2pm. Talk-in: 146.64 (-). HPARC, Tom Krausnick WC9F, E-Mail: wc9f@arrl.org Web: http://www.qsl.net/w8hp NY - YONKERS - Flea Market. Lincoln High School, Kneeland Ave. 9am-3pm. VE Exams. Talk-in: 440.425 PL 156.7, 223.760 PL 67.0, 146,910, 443,350 PL 156,7, Metro 70cm Network, Otto Supliski WB2SLQ, 914-969-1053. E-Mail: wb2slq@juno.com Web: http://www.metro70cmnetwork.com

#### JANUARY 22

FL - PENSACOLA - Hamfest, University of West FL ARC, Ray Killough KE4UNR, 850-968-1048. E-Mail: ke4unr@spydee.net Web: http://qso.arc.uwf.org/~hamfest MO - ST. CHARLES - Hamfest. St. Louis

Repeater, Brad Ziegler KC0CDG, 314-569-5775. E- Mail: kc0cdg@qsl.net NC - WINSTON-SALEM - Hamfest. Forsyth ARC,

John Kippe N0KTY, 336-723-7388. Web: http://members.xoom.com/w4nc/hamfest.htm NH - NASHUA - Hamfest. Res Ctr Church. NE Antique RC 617-923-2665

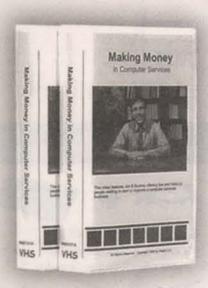
#### JANUARY 29

AL - GREENVILLE - Hamfest. Butler County Fairgrounds. 8am-3pm. Talk-in: 146.67 or 145.19. Butler County & Pike County RACES, Jerry McCullough KE4ERO, 334-382-7644. E-Mail: KE4ERO@alaweb.com

#### JANUARY 30

MD - ODENTON - Hamfest. MD Mobileers ARC, William Hampton N3WGM, 410-766-2199. E-Mail: diamondb@space4less.com Web: www.space4less.com/usr/mmarc

Continued on page 36



Thousands of companies pay big bucks to people just like you (and treat you like a hero!) for helping them select, install, program, network and operate computers simple tasks for you.

Afraid of starting your own business? Don't be! In Making Money In Computer Services, I'll show you how to turn your computer skills into a money-making machine, including valuable topics like Preparing Yourself to Run a Business ... Structuring Your Company ... Money Matters ... Marketing Magic ... Pitfalls to Avoid ... Management Tips ... Tax and Legal Issues ... and much, much more!

These are the same techniques I used to build my own computer consulting business. and have successfully taught to others. Now you can profit from them, too.

#### Two complete video cassetts

Making Money In Computer Services isn't Hollywood hype. It's two complete tapes of solid, nuts-and-bolts, practical instruction you can use immediately.

Whether you want to consult on the

Successful Entrepreneur and Computer Consultant Jon Bushey Reveals

## Secrets Of Making Big Money As A Computer Consultant

Full-time or on the side!

"My video will help you turn your computer knowledge into big profits. I know. I'm a successful computer consultant myself." Jon Bushey

side ... grow your freelance work ... or jump in with both feet ... Making Money in Computer Services is an absolute must. With the knowledge you'll gain, the errors you'll avoid and the profits you'll earn, my video is sure to pay for itself many times over.

#### Try it risk-free

If you're not delighted with Making Money in Computer Services, return it within 30 days and I'll refund the entire purchase price, no questions asked.

A live seminar with only half as much information could cost you a fortune, but you can enjoy Making Money in Computer Services in your home or office (and review it as often as you like) for just \$129.99, plus \$8 for shipping and handling.

You have absolutely no risk, so order now by calling toll-free 1-888-829-6200. Or, send \$129.99 plus \$8 shipping and handling for each set ordered to: Computer Consulting Video Offer, Rapid LLC, 3690 S 500 West, Suite 113, South Salt Lake, UT 84115.

#### Meet Jon Bushey

Jon Bushey teaches from experience. After decades in the software development industry, Jon

founded and became the senior partner of Rapid LLC, a computer consulting firm with a distinguished client list. Jon has been featured in numerous local and national publications including The Wall Street

Journal, and has appeared on national television, been a featured speaker at the International Developers Conference (DevCon), and has taught countless other computer consultants to launch their own successful businesses.

No one is better qualified to help you start or build your computer consulting business.



L_YES! I want to learn how to start or grow Bushey, the man who's done it himself and tau video <i>Making Money in Computer Services</i> , for (call for shipping and handling outside U.S.) penot satisfied, I may return my purchase within handling, no questions asked.	r just \$129.99 plus \$8 shipping and handling r set, for a total amount of just \$ If I am	For fastest service call toll free: <b>1-888-829-620</b>
I prefer to pay as follows:		THE PROPERTY OF
My check is enclosed. Please bill my:	Name	Clip and mail to:
☐ Visa ☐ MasterCard ☐ American Express	Address	Computer Consulting Video Offer
Account number:	City	- Rapid LLC
Exp. date:	State, Zip	3690 South 500 West, Suite 113
Signature	PhoneBest time to call	South Salt Lake, UT 84115.
(All orders must be signed.)		





A Specialist in "Hard to Cross House Numbers" Easy, Powerful & Fast. The Most Comprehensive Software Sold.

is Device Specifications & 75 to 250 Potential Replace

Replacement Numbers are Totally Global including Domestic, Asian, Europ House, Branded, as well as ECG, NTE, SK & GE. Displays Case Dra Lead Configuration & Pin-outs for many Devices. Coverage of Rement Numbers is Very Impressive. 7 Disk Set. (17 Meg decompress For DOS, W3.1 & 95, 98 & NT. Current Version 7.11

Includes: 4 HUGE Consumer Electronics Industry Directories 1-Consumer Electronics Parts Sources (Service) 2-Consumer Electronics tronics Parts Sources (Service) 2- Consumer Electronics 3- The Entire Computer Industry 4- Semiconductor

#1 Choice of Service Centers

Pentium P-75 -or- 486 DX4-100

Huge 10.5' Active Matrix SVGA Color Display (the Best)
(Much Sharper & Brighter than a standard display, a \$ 300 value)
33k FAX MODEM - 2 PCMCIA Expansion Slots
Dual Infrared Ports (Front & Rear)
Track Point Mouse All Standard Ports (1S,1P,1VGA,1Kbd)
Pop out - Hard Drive, Ram, & Battery
Ram & Hard Drive Expandable & Upgradable.
Includes Power Supply & Hydride Battery
Free Lifetime Tech Support Web Site Creator Software
Internet Ready, America On Line 4.X Latest Version
Fax Modem Software, Searchable Owners Manual s/w, W95
DX4-100 810Meg Hard Drive Standard -or- (2Gg only \$591)
16M Ram Standard -or- (optional 24M Ram \$241)
Pentium P-75 2Gig Hard Drive & 24 Meg Ram Standard

00/0 Financing on Credit Cards only Docks \$189 alone Pent-75 :39

Pent-75

of the IC Industry Every Cross-reference aster Earlier Editions Perfect for Service or Lite ign. Later Editions Perfect for Advanced Design

953Book Set \$29 ///////// 963Book Set \$49 ////// 97 3Book Set \$69 !! CD Rom \$ 99!! \$135! \$189! 98 3Book gone CD Publisher 99 3Book gone CD "

**IC Master** 

My GOD

EEM Contains the Complete Catalogs of Most Electronic Component Manufacturers & Distributors

97 4 Book Set only on CD \$35 98 4 Book Set only on CD \$55

#### *IBM Docking Stations*

This is not just a port expander it's a full blown docking station
You can add ANY desktop ISA card and it will work with your IBM laptop
Imagine the posibilities. Add a TV card and watch TV while you comput
ISA computer card hides in the base of the unit.

FREE Local Area Network (LAN) card (a \$79 value ) Notebook Snaps onto the dock.

Expansion Port for optional CD Rom Built-in Speakers Built-in Power Supply & Fan SCSI Expansion Port / Parallel / Serial / Keyboard / Mouse / Monitor / Stereo in & out FREE Local Area Network (LAN) card (a \$79 value ) Front panel headphone Jack Hidden Carry handle LED Status Indicators Color Black (matches notebook) ISA Port cover & Key optional (not required)

1 Year Warranty - Satisfaction Guaranteed - The Friendliest People - The Best Customer Service **Email for Detailed Information** 843-650-5700 For Questions-or- email: netcomd@aol.com PAYMENT PLAN with Credit Card -or- Layaway ONLY COD's SINGLE PAYMENT ONLY ORDERS ONLY 800-733-3733 ORDERS ONLY FAX 843 650 5777 10 - 8 EST Mon - Fri

## ELECTRONICS Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware, software, circuits, electronic theory, troubleshooting, and anything else of interest to the hobbyist.

Feel free to participate with your questions, as well as comments and suggestions.

You can reach me at: TJBYERS@aol.com TJBYERS@juno.com

or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.

#### What's Up:

Lots of useful circuits, ranging from a basic 555 timer to 60 Hz notch filters to remote phone relay. And some theory, including a deeper look at

DSS polarization,
Playing with lightning,
NASA style. Plus some
useful tech support
Web sites.

#### Flyback Is Back

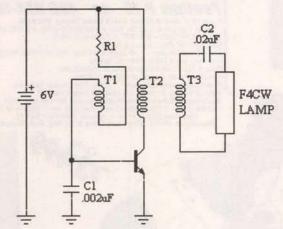
I have this little fluorescent light that contains a transformer, one transistor, four caps, two resistors, and runs off four (1.5V) ordinary batteries. I'm trying to learn transistor theory, but this circuit eludes me because the base voltage seems to be wrong. Here are the measured voltages on the transistor using a 6.8-volt supply:

Vc = 6.5V Vb = 1.14V Emitter is tied to ground.

Now, my question. This seems like a VERY simple circuit, but I'm just not sure how it works. Is this transistor being used as a switch in what appears to be a flyback transformer? And why is the base voltage 1.14 volts when the textbooks say it's supposed to be 0.7 volts?

Via Internet

You're quite right. Your fluorescent light is driven by a flyback circuit. Here's a diagram of one that I bought from a hardware store for about \$10.00.



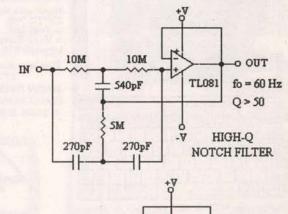
Although this version uses just one resistor and two capacitors, it works the same. Basically, the transformer is the heart of the circuit and the transistor is nothing more than a switch. When power is applied, current flows through the resistor and turns the transistor on, which causes current to flow through the T2 winding of the flyback transformer. This induces a voltage in the T1 winding, which opposes the base current that is, it tries its best to shut off the base current. At some point, it succeeds and current ceases to flow through the collector, which causes the magnetic field to collapse and generate a high voltage in winding T3 to spark the fluorescent lamp. Current now flows through the base again and the process starts all over. The frequency of oscillation is set by the flyback transformer, and is typically somewhere around 25 kHz. Why is the base at 1.14 volts? Because of the way your voltmeter interprets the voltage. Your DMM is a digital meter and not a true analog device. That is, it converts analog voltages into digits using an A/D converter then displays them as numbers. In the conversion process the highvoltage kick is integrated into the normal 0.7-volt base voltage, hence 1.14 volts. An analog meter with a needle would be closer to the true value, but will still show a little higher than 0.7 volts because of the flyback effect.

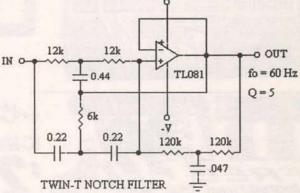
#### **Electric Motor Monitor**

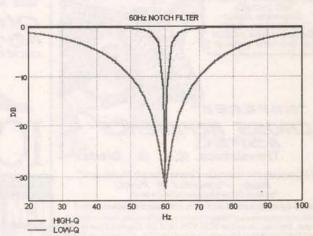
When an electric motor drives a mechanical system, it experiences variations in load caused by gears, pulleys, friction, bearings, and other conditions that may change over the life of the motor. The variations in load caused by each of these factors, in turn, causes a variation in the current supplied to the motor. These variations modulate the 60 Hz carrier frequency and appear as sidebands in the spectral plot. Is there a circuit to demodulate the signal from the 60 Hz carrier and present a spectral display to an IBM PC?

Danny Meadows Boron, CA

This is actually an easy question, but not a cheap solution. All you need is a 60 Hz notch filter like one of the two circuits below (this is the cheap part) and a plug-in oscilloscope board for your PC. These boards range in price from \$200.00 to over \$1,000.00, and generally come with spectrum analyzer software. Now what's going to happen is the PC screen will show you a range of frequencies and their amplitude — minus the 60 Hz power. These screens can be saved to a file and compared over a period of time as the motor/mechanism ages.







These two filters are essentially the same, with the exception of the feedback path. In the twin-T filter, the signal is returned to ground, which lowers the Q of the circuit. In the high-Q circuit, the signal is bootstrapped to the output of the op amp. This raises the Q of the filter and sharpens the notch. You'll have to experiment with the bandwidth of the filter to find the response that works best for your application. I suggest you go to the "Test & Measurements World" Web site (http://www.tmworld.com) for more information on this topic. Meanwhile, here's a short list of vendors who

make oscilloscope/spectrum analyzer boards.

**Allison Technology Corporation** http://www.atcweb.com/default.htm 1-800-980-9806

> **Keithley Instruments** http://www.keithley.com/ 1-800-552-1115

PC Instruments, Inc. http://www.pcinstruments.com 330-762-8500

#### **Satellite Antennas Polarization**

Even though I've taught high school electronics for 40 years and have been a ham for 50 years, I always have questions. What I'm interested in is satellite antennas. What is RHCP and LHCP? How is it developed? How does it look as a diagram? I own a 10-foot dish and know I must change polarization using the +13 and +18 volts, but is the satellite antenna at 45 degrees when my receive antenna is at 45 degrees? Isn't the satellite spinning? Where can I get more information on satellite antennas?

> Jim Allen W8FJD via Internet

. This is a good question because the answers are often confused by "experts" in the satellite field. Technically, the two signals are circular polarized: RHCP means right hand polarization and LHCP stands for left hand polarization. Here's how it looks and how to remember it.

Hold out your fists with your thumbs pointed up. Notice that the right fist has the fingers curled counterclockwise and that the left fist has the fingers curled clockwise. This is exactly how the satellite distinguishes between the signals - one is clockwise and the other is counterclockwise. By doing this, the satellite can double the number of channels it can send. But here's where the technophobia gets in the way. If you go to the Good Guys, they call RHCP horizontal polarization and LHCP vertical polarization - which it can't be because, as you astutely point out, the satellite has a spin to it. There's no way the satellite can guarantee horizontal and vertical orientation, hence the reason for RHCP and LHCP. Here's a good Web site for more information on the subject:

http://www.21st-satellite.com/sat\_tv.html.

#### **Current A-to-D Converter**

. I know DMM meters can read current and display them in digital format. How is this accomplished? I've been looking for a circuit that will allow me to measure telephone line current and include this circuit in a handheld device I am working on.

Tim Edwards via Internet

Basically, what the DMM is doing is measuring the voltage drop across a series resistor. Using Ohm's Law, E = IR, we can see that anytime current flows through a resistance, voltage is developed. The off-hook current through the phone line is typically 20 mA, so let's use this value to calculate the size of the resistor. That formula is R = E/I. Now we have to pick a voltage. Let's say that in one case we need one volt to trigger the mechanism and in the other we want 200 mV as the trigger point. Here's the math.

R = E/I = IV/20mA = 50 ohmsR = E/I = 200 mV/20 mA = 10 ohms

What you need to do is break one of the phone lines and insert the resistor. You can now use any A/D device to translate the line current into a voltage by rearranging the Ohm's Law formula around to I = E/R. If the R is 50 ohms and the E is 0.5 volts, then the line current is 10 mA (I = 0.5V/50 ohms = 10 mA), I don't know what your application is, but a very cheap way to digitize voltages like this is the CA3162 chip from Harris (who has recently become Intersil). It's available from several sources, including Digi-Key (1-800-344-4539; http://www.digikey.com) and Jameco (1-800-831-4242; http://www.jameco.com).

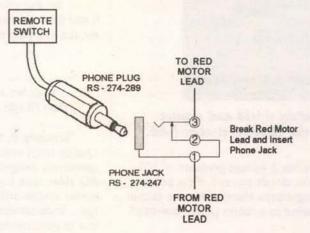
If, however, all you want to do is activate a relay when the receiver is off hook, I'd use the simple remote switch relay circuit shown in the "Add Remote Control to Cassette Recorder" question below.

#### **Add Remote Control to Cassette** Recorder

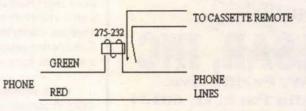
RadioShack has a new nifty miniature standard cassette tape recorder, the Optimus CTR-114 (14-1120). It has automatic reverse, two speeds, normal/extended recording speed, vox — everything one might want, except for one. They didn't put a remote jack in it for activation by a telephone line or remote switch. Could you give me a circuit that can be installed within the unit that will work with a remote switch? Perhaps you could show a picture and indicate where a jack might be installed and how it would be wired into the existing circuit?

B/O/B via Internet

What I'd do with this recorder is control the remote function via the motor, not the electronics or battery power. When the motor is off, the tape doesn't move but the electronics are active. This ensures that all your settings are in place and ready to roll when the motor is turned on. However, you need to have the motor active when the remote switch is unplugged, which is easily done using a closed-circuit jack like the RadioShack 272-247. Here's how the jack is wired.



First, find a convenient spot to mount the jack and drill a hole. Next, locate the red wire going to the drive motor and cut it in half. Now, insert the jack into the cut line as shown above extending the wires, if necessary and mount the jack into the case. Finally, wire the remote switch into the plug. Need a remote switch for the phone line? Here's one that's easy on the pocketbook and easier to build.



In this circuit, a relay is put in series with the phone line. This simple solution works because both the dial tone and relay are current activated. When you pick up the headset, a current of about 20 mA flows through the red and green wires. The voltage isn't

#### D.T.M.F. DECODER

#### For interconnect and remote control applications

The Model NC401 NC401 is a microminiature DTMF decoder, designed for \$59.95 selective control of local or remote applications. Measuring .80"Wx1.37"Lx.23"H, the NC401 combines three distinct, multi-addressing decoders offering multiple user-config-urable functions. All programmed features are stored in non-volatile E2Prom memory and are easily programmed by means of a conventional DTMF encoder or the Model NC500 Universal/P.C. programmer. This highly engineered decoder is ideal for portable radio appli-cations having limited space for accessories. The NC401 comes complete with microminiature 14 pin header and 12" color coded cable assembly.

Nor-tax Doc. #5545

#### **VOICE SECURITY ENCRYPTION**

Model The Model NC802 NC802 is a miniature inversion scrambler designed to provide intermediate level security for \$59.95 two-way radio voice communication systems and is a perfect, cost-effective solution to entry-level voice scrambling as a defense against unauthorized or casual listeners. The NC802 provides eight user selectable carrier codes commonly used by other manufacturers and interfaces easily to most radios with near transparency to the user.

Nor-fax Doc. #5759

For Detailed Specifications or Product Catalog call our 24-Hour NorFax retrieval system at 530-477-8403 or on our Web Site at www.norcommcorp.com



800-874-8663

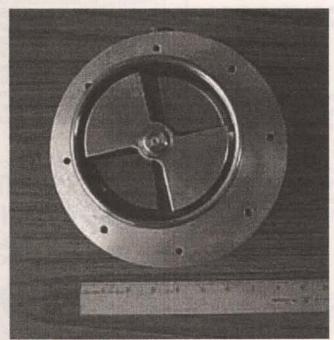
15385 Carrie Drive Grass Valley, CA 95949 USA important — it's the current, which is enough to pull in the relay and start the recorder. When you hang up, the relay drops out and stops the tape.

#### Field Mill Monitors Lightning

Are you familiar with a device called a "field mill?" It's a machine that's used to detect atmospheric electrostatic charge. NASA uses them around the Cape Canaveral launch sight to warn them of potential lightning storms prior to rocket launches. Apparently, they have a slowly spinning disk, possibly with slots as part of the sensor unit, to monitor the amount of the charge. I'd be interested in hearing about field mill theory.

Forrest Cook WBORIO via Internet

A field mill monitoring device is nothing more than a very sophisticated electrometer. There is always an electrical charge in the atmosphere. What a field mill does is monitor the atmospheric charge for voltage and polarity, looking for clues that could indicate a change in the weather. However, electrometers are notoriously unstable, which leads to inaccurate measurements. The field mill solves this problem by placing a bowtie-shaped shield over the electrostatic sensors. A small motor spins the rotor to alternately shield and expose the sensors to the atmospheric charge, thus converting it into an AC signal. Op amps have long used this trick to minimize drift by alternately grounding the input and then applying the signal voltage via a circuit called a chopper.



The "bowtie" rotor spins to alternately shield and expose the pie-shaped inner electrodes to the external electric field.

Under normal conditions, the atmosphere has a voltage graduate of 100 volts per meter with the earth negative and the clouds positive. If the polarity reverses, it could indicate an advancing lightning storm. Here's what the output of a field mill looks like over an eight-hour period as a storm passes overhead. The spikes are lightning strikes.

## PRINTED CIRCUIT BOARDS

OUALITY PRODUCT FAST DELIVERY COMPETIVE PRICING

- \* UL approved
- \* Single & Double sided
- \* Multilayers to 8 layer
- \* SMOBC, LPI mask
- \* Reverse Engineering
- \* Through hole or SMT
- \* Nickel & Gold Plating
- \* Routing or scoring
- \* Electrial Testing
- \* Artwork or CAD data
- \* Fast quotes

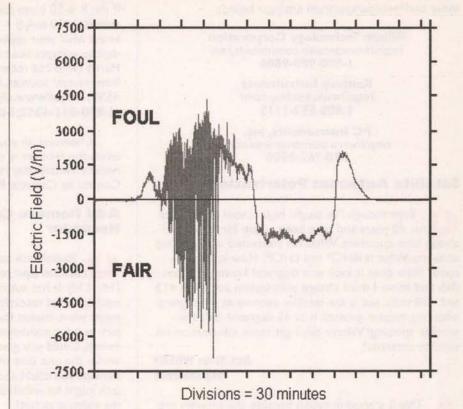
PROTOTYPE THROUGH
PRODUCTION

## PULSAR, INC

9901 W. Pacific Ave. Franklin Park, IL 60131 Phone 847.233.0012 Fax 847.233.0013

Modem 847.233.0014

yogii@flash.net - flash.net/~yogii



Here are the specifications of a typical field mill instrument, like the kind used to monitor the weather around launch sites.

Number of Electric Field Sensors: 10, expandable to 16. Electric Field Mill Sensor Specs:

- DC to 10 Hz Dynamic Range: ±1 volt/meter to ±32 kilovolts/meter.
- 16-bit digitizer (50 samples/second).
- · Brushless DC motor for low noise and low maintenance.
- · Remotely controlled self-calibration.

#### **Tape Trials**

Is there any difference between a regular high-quality VHS tape (used for everyday recording) and an extra high-quality VHS tape (used for hifi and library recording)? Even though the extra high-quality tape says it's better, the everyday tape seems, logically, to be the more durable tape.

Edvis Shahbazian Glendale, CA

Well, let me take a few excerpts from a couple of TDK press releases, then I'll add my two cents and let you decide for itself.

"January 9, 1997 — TDK today announced its new line of Advanced Quality (AQ) video cassettes, an affordable, high-quality VHS video tape that's specifically designed to withstand the rigors of daily VCR use. The super-strong AQ video tape boasts superior durability, thanks to a specially engineered binder system and an extra-strong base film that resists stretching and breakage ... Tests conducted by TDK reveal that the formulation shows virtually no loss in performance after as many as 200 complete record/playback cycles."

"January 9, 1997 — TDK, the world's leading manufacturer of high-quality video tape, today announced it will highlight the extraordinary DSS satellite recording capabilities of its advanced Hi-Fi and HD-X Pro VHS video tape with on-pack DSS icons. According to Tim Sullivan, TDK's VP of Marketing, 'To capture the great quality of DSS pictures and sound, you need a tape designed for maximum resolution, low noise and full frequency response — even at EP recording speeds. In this critical six-hour mode, where most tapes achieve poor resolution and less than ideal color reproduction, our advanced formulation E-HG Hi-Fi and HD-X Pro cassettes can capture DSS broadcasts with superior clarity and true home theater sound.' TDK's Multi High-Press Calendering process, along with a high-pressure Shine Finishing process creates a magnetic layer with the smoothest, most mirror-like surface achievable."

If this sounds confusing to you, you're not alone. Lots of times the advertising department is unclear on the concept and makes misleading statements. Basically, the price and quality of the tape has three parts: the size of the magnetic dust, the durability of the plastic backing, and the polish of the surface. Obviously, the coarser the magnetic media, the lower the cost and video quality. This is normally where the cheap tapes cut corners. This also leads to a more abrasive polish, which wears out the heads faster. At the top end, you'll

#### Electronics Q & A

find highly-polished tape with grain so fine it puts cigarette smoke to shame. In between are the "premium" grades, which is what you'll find on most store shelves. The finer the grain, the better the video (or DSS) image at any tape speed — and the longer the tape and your VCR heads will last. Like many things in life, you get what you pay for. Tape quality can usually be judged by it's price.

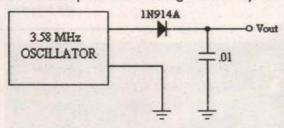
Which tape is best for you? It all depends on what you plan to use it for. For a daily soap that you record while at work to watch that evening, cheap to premium quality is perfect. For movies that you want to save, choose no less than premium quality; they bear the designation high-grade to very-high grade. If you're into digital TV or DSS and want to save the broadcast for posterity, use S-VHS quality tape.

#### No Free Lunch

I have a RadioShack Micranta range doubler (22-204A) volt-ohmmeter. On all ranges, except current and ohms, my meter goes off scale when I try to measure a 5-volt, 3.58 MHz squarewave by connecting the meter through a 200 pF cap. It even happens on the 1000V AC range. When I reverse the leads, the needle slams negative. I have fun showing this quirk around. Not all meters will do this. There is no measurable voltage across the meter terminals, so I assume the needle movement is caused by magnetic energy (monopole) deposited on the armature. This could be a new power source. Please let your readers know.

name withheld via Internet

- So tell me, how many 40W bulbs were you able to light from this untapped power source? No, I'm not making fun of you, because this phenomenon has tricked more than one person. In fact, I interviewed a man from Mississippi several years ago who actually tried to patent this idea as a "perpetual" power source. Sorry to say, though, there's no such thing as a free lunch. Yes, the meter is measuring unseen energy — RF energy, to be exact. The reason the needle pegs is caused by something called dv/dt — the energy spent on raising the voltage from zero to V+ at an extremely fast rate. Want to measure the true power this circuit generates? Try this:



Basically, the diode rectifies the RF output and the 0.01uF capacitor filters it. I suspect the output will be 2 to 3 volts unloaded. Slap a 100-ohm resistor across the output, though, and you'll discover there's not

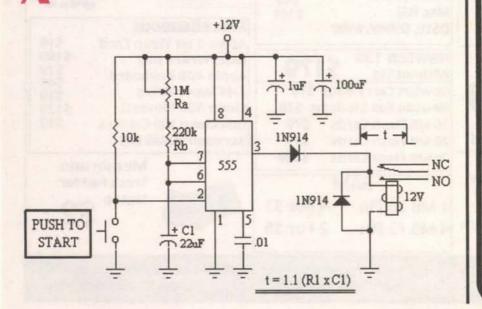
as much power there as you suspect as the voltage drops to about 0.2 volts.

#### 555 Relay Circuit

What I need is a circuit which can be used in a 12-volt automobile that, once activated, stays on for an adjustable period of 10 to 30 seconds. I've looked in every book and publication I can get my hands on, but find nothing anywhere close to what I want. Can you help me?

Frank Schwartz via Internet

This requirement is easily satisfied using a 555 timer chip.



Metric Equipment Sales, Inc.

800-432-3424

Fax: 510-264-0886 www.metricsales.com



Scopes, Meters, Analyzers, Power Supplies, Signal Generators, Counters, Recorders and more

Hewlett-Packard, Tektronix, Fluke, Dranetz, TTC, Anritsu, Wavetek, Keithley, and more

#### **Test & Measurement Instruments**

Over 7000 Models • 6-Month Warranty Save 30-90% • 5-Day Free Trial

Write in 56 on Reader Service Card.

## **Electro Mavin**

Has To Much for the AD IIII
We are Busting at the Seams!!!
So Please....

Stop by and Check Us Out on the WEB

This is all you'll need to get to the fabulous world of Mavin Specials

Like....

Soyo Super Stable Socket 7 Mother Boards #SY5EMA

Bus Over Clocks to 124 MHz -Uses Pentium class CPU up to 500 MHz Check out our low price.....

Other Items Include....

GPS Engines w/Antenna
Microwave Goodies and Stuff
56K V.90 Modems, 40X CDROM Drives
Dealers Special on Designer Mice

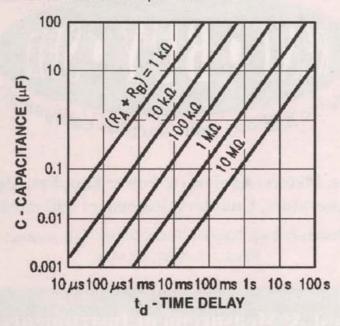
We Also Buy Connectors, Contacts, Raychem

#### **Electro Mavin**

800-421-2442 or FAX 310-632-9867 E-Mail john@mavin.com

E-Mail mark@mavin. com

This is your basic 555 monostable multivibrator. When a negative pulse is applied at pin 2, by pressing the Start button, it turns off a transistor that normally shorts C1 to ground. This causes the output (pin 3) to go high. The capacitor now charges at a rate determined by the series resistors (Ra and Rb), using the formula t = 1.1 (R1 x C1). When the charge on C1 equals 2/3 Vcc, the output goes low and the timing cycle screeches to a halt until the Start button is pressed again. With the values given, the timer ranges from about eight seconds to a little over 30 seconds. Here's a graphics that you can use to calculate different time-out periods.



#### **Need Technical Help? Check Out These Web Sites**

HelpMe — http://www.helpme.com

Interesting tech stories plucked from various publications and links to other help Web sites.

Windows 95 Information Site — http://www.mbnet.mb.ca/win/Window95.html Links to Microsoft tech support and independent Windows 95/98 support

O & A Editor

#### MAILBAG

Dear TJ Byers:

In your discussion of digital thermometers in the July '99 issue, you described the Kelvin with "It's the same measurement as centigrade." As I recall, "centigrade" is a pseudo measurement that went out with high-button shoes. It's obvious that many of us living in North America abhor the metric system, and when some reporters saw "°C" on a temperature dial, they invented an avoirdupois scale to fit "degrees C" without going metric. People are now using the world-wide scale of Celsius. "Centigrade" has passed on, along with micro-micro-farad and "mickey-mikes" (now picofarad).

via Internet

Dear TJ Byers:

There was a question in your last column about how to find shorted components the easy way. A method I've used in business radio, etc., involves two multimeters. Set one of the meters to ohms, and attach it to the power input points of the unit under test. This will give you a low current voltage drop from the meter to the short. Now, take the second meter on volts (a DMM works best), and search down the circuit until you find a component with zero volts to ground across it and you are on the doorstep of your short. There are some exceptions to the above method, but it will eliminate a good share of the circuit and put you in the area of the short. One such case is that in which you have more than one bad component to find, but it will lead you to them one at a time if you just hang in there. Please pass this one along to the next generation of technicians. Thanks.

**Lewis Baker W7PAW** (Ret. Elec. Tech) via Internet

We accept Visa, Mastercard, AmEx, and Discover

### **Attention: Gearheads**

www.shrevesystems.com

To Order Call 1-800-227-3971

Fax: 318-424-9771



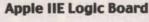
PowerMac 7200 75 Mhz PPC 601 4 168 pin DIMM slots **Build your own Mac!** \$79 Brand New!



**Peltier Junction** with heat sink 13/16îx 13/16î \$10 each or 3 for \$25



**Texas Instruments Color Composite** Display **Great for Surveillance** Refurbished \$99







**LC Power Supply** +5V, -5V, +12V Output \$5 New

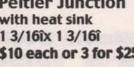
## Global Village Bronze CMS Tower SCSI Case

**External Modem** 2400 Bps/9600 Fax

**Logic Boards** 



Q610 Logic





\$79 Q660 Av Logic Q650 Logic No 0800 Logic **Processor** Q840 Logic Q900 Logic



#### MacAlly ADB Keyboard



**PDA Genuine Leather Carry** Case Let your palm of luxury!

## **Power Supplies**

Apple IIE \$59 \$69 Apple IIGS \$99 Mac IICX, Ci \$49 Mac II, X, FX \$49 Mac IISi \$149 Q610, 660AV, 6100



pilot lead the life

#### Newton 130

Without Lid Newton Carry Bags \$19 **Newton Fax Modems \$19** 16 MB Flash Cards 20 MB Flash Cards \$99 24 MB Flash Cards \$129

#### RAM

1 MB 30 Pin 4 For \$1 4 MB 72 Pin 2 For \$5



Holds 4 5.25 full height drives

Claris Works 3.0 For PC/Mac **EDOCS** 

\$19

\$49

\$19

129

Miscellaneous	
Apple 8 bit Video Card	
LaserWriter IINT	\$
Apple ADB Keyboard	
1.44 Super Drive	
Clone ADB Mousell	\$
Quicktake 100 Camera	



Bernouli 90 MB EXT

Membrane Track Pad for laptop

\$25 minimum order

Shreve Systems 1200 Marshall st Shreveport, La 71101

Returns subject to a 15% restocking fee. Prices are subject to change without notice. We accept Visa. Mastercard, AmEx. Discover

## We've Got It! MGM Flectronics

Prices effective September 17, through October 29, 1999.

For over 20 years, MCM has been the leading supplier to the electronics service industry. Huge inventory, rapid delivery and competitive prices have made MCM the choice for:

- Hobbyists Educators
- Service Technicians
- Installers

#### 4" LCD Color Monitor with Audio

 Ideal for automobile multi-media and security use •TFT type display Resolution 383 (H) x 234 (V) •Internal 500mW audio amplifier with speaker •A/V inputs and outputs for easy daisy chaining •Requires 12VDC 350mA •Includes AC adaptor and cables • Regular price \$179.00



#### 88~108MHz FM Transmitter

Pre-assembled board accepts line level input and transmits audio to any standard FM radio. Output frequency can be adjusted anywhere in the 88-108MHz FM band.





#### Multiple Voltage 2 Amp Power Supply

Indispensable accessory for any hobby or tech bench. Rotary switch selects 3, 4½, 6, 7½, 9 or 12V output, Ideal for battery operated devices or your latest project. Regular price \$16.95.



#### Aluminum Tool/Equipment Case

#### Clarke

Includes one tool pallet and pre-cut foam bottom. Ideal for carrying test equipment with small hand tools and accessories. Black finish, measures approximately 19" x 14" x 6". **Regular** price \$51.50.



#### Soldering Station

#### TENMA

 Perfect for all types of board level and precision work . Digital LED display shows temperature and setpoint •Stand has tray for

included cleaning sponge • Regular price \$119.00





#### CCD Black and White Camera

 Ultra compact, measures only 1%" square • %" image device •430 line resolution •3.6mm lens, 92° viewing angle •Requires only 12VDC, 100mA •Standard NTSC composite video output • Regular price \$79.95



#### RF Modulator

\$7000

Outstanding price on this popular audio/video/ surveillance accessory. Accepts standard A/V signal and places it on channel three or four. RCA type inputs, "F" type output. Requires

R.F. MODULATOR CHANNEL 117VAC. Regular price \$19.95. \$ 1095

## 8" Rubber Surround Polypropylene Wooter

#### MCMAUDIO SELECT"

Popular woofer design is the foundation of many home and auto speaker systems. 70W/100W RMS/peak capacity, frequency response 30Hz~3.5KHz. 8ohm. Other sizes available. Regular price \$13.50



#### DMM with Logic Function

3% digit LCD display meter measures AC/DC voltage to 600V, AC/DC current to 10A, resistance to 2000Mohm, capacitance to 20µF, transistor he and provides diode and logic test. Includes holster and test leads. Regular price \$65.95.



#### 10MHz Oscilloscope

- Ideal for the student or hobbyist
- Norm, auto, TV, sync and external triggering • Operates on 115/230VAC, 50/60Hz
- Includes test leads



#### Same Day Shipping! In stock orders received

by 5:00 p.m. (YOUR TIME), are shipped the same day.



SOURCE CODE: NVM27

#### Nickel-Metal Hydride Cells

To take advantage of special pricing on

the items listed, please provide this code: NVM27

Get NIMH performance in a standard "AA" or "AAA" cell. Performance is 50% over that of Ni–Cad batteries of the same size. Sold individually.

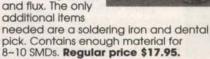
(1-9) (10-49)(50-up) Order # Size 29-2615"AAA" \$3.59 \$3.29 \$2.99

29-2620"AA" 4.19 3.89 3.59



#### Chip Quik™ SMD Removal Kit

Provides the items you need to safely remove and replace surface mount devices without the need for costly rework equipment. Includes special removal alloy, desoldering braid and flux. The only





#### Dental Type Precision Tool Kit

Stainless steel probe set is and invaluable aid to anyone doing board level soldering repair. Includes straight, curved and angled tip probes.

Regular price \$10.25



#### 100W Subwoofer Amplifier Module

Ideal for anyone interested in making their own powerful subwoofer Internally, this amplifier isolates, then sums the left and right inputs to give a single mono channel with 100W RMS output @ 4ohm, 85W RMS @ 8ohm. •Speaker

- level inputs Satellite outputs
- Line level inputs
- Auto turn-on 12dB continuously variable 60Hz~160Hz crossover •Adjustable level control •0°/180° phase selector •Fully sealed rear housing
- •Requires 81/2" square opening •Call for quantity pricing





For complete ordering information on the

NEWPORT, LC-075, 10X COLLIMATING TELESCOPE

The LC-075 is a general purpose laser collimator optimized for low wave front distortion at infinity. Oversized entrance aperture of 7mm for ease of alignment. Wavelength: 400-700nm, Exit aperture: 18.8mm, wavefront distortion at infinity less than 1/10 wave. Transmission: 90%. Used in excellent condition. Ltd. qty.

Newport price: \$775. OUR PRICE.....\$349ea.



SUPERIOR FLECTRIC SLO-SYN 3180-PT125, STEPPER DRIVERS

These drivers are removed from equipment and in good condition. They are designed for use with an external indexer. We have no documentation for these units. They are a compact 7"x5"x4". We always sell out of these so don't delay. Verylimited quantity

SPECIAL....\$139ea. or 2 for \$249

#### PARKER-COMPUMOTOR, SM231A BRUSHLESS SERVO MOTOR

w. SM series with optical encoder feedback 1000PPR) Rated shaft autput power is 205 watts. Stall current is 2.1 Amps. Rated speed is 7500RPM, forque at rated speed: 2.37 lb.-ln., Shaft diameter. 0.25°. Full specs are available on the web at otor.com/catalog/SMse



5598 ndf Size-4" x 3 3"H x 2 25"W sure to sell out. Very limited quantity. SPECIAL....\$149ea. or 2 for \$269

#### MINIATURE and, PRECISE. PORTESCAP, SWISS, GEARMOTOR.

State of the art "ironless" type, mini motor type M11-210-54-0 with approx: 40:1 gearbox. Size: 16mm d. x 43mm L Operating parameters: @6VDC input, 8mA, 141RPM No Load, @ 12VDC input, 12mA 290RPM No Load

PORTESCAP, TYPE B: \$15ea. 2 for \$27, Special....10 for \$125



**WORLDS SMALLEST** \*\*\* 100mW \*\* VIDEO TRANSMITTER, ON SALE

Incredibly only 0.98° x 0.8° x 0.037° in size. Transmits crystal controlled hi-res. images with 100mW output! The ransmitter you've been waiting for. Shown actual size. Smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned. Receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3° F cable for

TV Included. Perfect with our GM1000A. Both will fit in a cig. pack with battery!

SPECIAL TVX-100.\$159. with GM1000A CAM .... \$209.

#### NEW! 0.008lux, COLOR NIGHT VISION CAMERA! UNBELIEVABLE LOW LIGHT PERFORMANCE. Our GMV-2K, DOES it in COLOR TOO!



For covert, military and scientific applications that must be color this is it. Performance is enhanced through low speed electro A shuttering and digital frame

memory. With an auto iris lens. 24 hour monitoring is possible. Auto ensitivity mode starts as it becomes dark. Eight Gain/Shutter modes are iser selectable. Normal, X4, X8, X16, X24, X32, X64, X128. These provide rame rates of 60, 15, 8, 4, 3, 2, 1, and 0,5 frames per second, Auto Manual white balance. Aluminum housing with dual 1/4x20 mounts. Specs: 1/3" CCD, with 291K pixels, 320 Lines, <1 Lux std. mode sens., 12VDC @200mA, Std. video out on BNC. Size: 54mmx50mmx94mm long. With pwr. adapter. All functions can be externally controlled via an 8 pin nini DIN. Uses std. c-mount lens not included.

Special Item, GMV2K......\$589ea.

4mm, f1.4 A/I lens with custom cable... \$119eg

#### GOLD, SMA CONNECTOR



Right Angle for PC board mount. New. Similar to Pasternack #PE4178. They are individually bagged , 75 Ohm type.

Regularl 5.95 ea. Stock up now, with our super speciprice. SPECIAL......5 for \$10. or 20 for \$35 Regular

ULTRA PRECISE, KENSINGTON LABS, XY STAGE.

Model 8500-6X, 6'X6' of high performance travel. One of the best linear stages available. Highly repeatable, ultra-precise. Precision ground surfaces result in

laboratory-grade performance. Linear glass scale, internally attached to the table, all drivetrain errors n when an encoder is System provides up to

system provides up it.

mm. Bull from stress relieved 7075 aluminum. Crossed-roller bearings fo excellent stiffness, load capacity and lifetime. Combined with a very low friction preloaded leadscrew and DC servo motor arive provides 25, Sze-hour MTBF, 100 mm/sec maximum speed and >50kg load capacity. Size-thour MTBF, 100 mm/sec maximum speed and >50kg load capacity. Size-8500-6, XY STAGE......\$1295 Very good condition.

#### NEW. GM960 TIME LAPSE VIDEO RECORDER

Finally a brand new, 4 head, T/L recorder h all the features at a price you can afford Features include:

Up to 960 hours on a standard T-120 VHS tape

12 different modes for record and playback
 Audio recording in the 12H and 24H mode.

30Day memory backup • Easy mode setting.
 On- screen menus • Auto-Repeat recording mode • Serial or One-shot recording
 Time, Date, speed, and Alarm indicators on screen. These defuxe units are front loading and are 14"W x 3.5"H x 12.2"D, 110VAC powered.

SPECIAL....\$699ea.

#### SEPTEMBER SPECIAL PRICE BUSTER DEAL. NEW, SHARP, YH-7B50, COLOR, CCD CAMERA,

Now available for a fraction of its original price. Great looking styling. Camera has a very stable, manually adjustable pan and tilit base. Base is removable for tripod mounting via standard 1/4-20 mount on bottom. Front panel LED power indicator. Excellent video performance packaged in a sturdy 2.7°W x 1.4°H x 5.8"L, 11 oz. package. Simply connect camera to any "Video Input." RCA cable supplied. Camera has 5.6mm lens with fixed focus from 18" to infnity. No adjustment required!



Power is 6 VDC from power adopter also included. 1/3° CCD, 300tines resolution 25% better than standard VHS! Auto white balance. Perfect fro any general purpose video application. Brand new, in original sealed boxes. Don't miss out on this super special deal. YH-7B50 COLOR CAMERA...\$59ea. Super deal 2 for \$99

FUJINON, 14X40, IMAGE STABILIZED BINOCULAR

New, Techno-Stabi 14 power, designed for use on boats helicopters, cars or anything else that floats, flies, or rocks and rolls. State of the art Digital Image Stabilization provides rock steady images. Dual piezo vibration sensors and solid state gyro position sensors are linked to microprocessor controlled direct drive motors. This system provides an amazing +/- 5 degrees of compensation! The opare completely multi-coated and 100% waterproof.

fog proof and nitrogen purged. The complete pockage includes a flotation/padded neck strap, lens covers and a Pelican brand waterproof carrying case that also floats! I have personally used these and they are

TECHNO-STABI BINOCULAR...... ..\$1099ea.

#### NEWPORT TRANSLATION STAGES also a few other goodies too! MODEL: DESCRIPTION: FACH LAB JACK 360 deg. Rotary Stage with Clear Aperture. PSA-2T \$129 625A-4 Laser Holder \$149 Rotary Stage Translation Stage 481A \$189 \$249 M36 460A-XY X-Y Translation Stage \$189 3 Axis Trans. Stage M37 415 Vertical Trans. Stage \$129 M360-90 Mnting. Plate 90deg. \$29 Translation Stage Magnetic Mtg. Base M436 \$199 M150 Linear Trans. Stage INTERFEROMETER 420 \$119 HP10703A \$129 HP10702A INTERFEROMETER \$129 RUCKER & KOUS 222 X-Y-Z MICRO POSIT. \$ 50

10V @ 2.5 AH SEALED, LEAD ACID, PACK Each pack consists

NEW GM182, 580 LINE, CCD CAMERA,

1/3" CCD, 580 Lines Res., 0.1 Lux sens., AGC, Auto Shutter, Pwr. 12VDC @120mA, 3.6mm, 71° FOV, Real glass lens. Focus from 10mm to infinity. Standard NTSC video out. 1/2 once! SENSITIVE to IR.

MICRO CAMERA, with MIRROR IMAGE

rfect for "rear view." 1/3" CCD, with 266K Pixels. 410 Lines Res. 0.3 Lux sens. AGC and Auto/Man Shutter Low Power 12VDC

GM251, with AC power adapter.....\$69ea.

ULTRA MINI and WEATHERPROOF, "LIPSTICK" CAM

©100mA 3.6mm, 92° FOV, focus from 10mm to infinity. A real glass lens! WHY BUY DISCONTINUED OR SURPLUS? New first

Sleek black anodized, alum. housing, O-Ring sealed & RAINPROOF. Adj. Hilling mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. < lounce! IR SENSTIVE. 23mmdX50mm 36" cable with BNC video & DC barrel jack.

PINHOLE Model. So finy you can install it directly into a door. Only a 0.9° diameter holet Specs as above.  $90^{\circ}$  FOV Pinhole lens. 1/2 once! Size only 23mm d.x35mm long. Think of the

GM-200K-STD....\$99 OR GM-200K-PH lens....\$99

quality Standard NTSC video out. 1/2 once! IR SENSITIVE!

GM182, with AC power adapter. SEPTEMBER SPECIAL......\$169ea

Size: 1.7\*sq. x 1\*d. with 6\* leads. Superior quality for demanding

of five, 2 Volt cells. Each cell the size of a 'D' batte Arrainged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Perfect for high drain applications. Make custom packs of ar



约4 123

Size: 7.5°L x 2.8°H x 1.5°D 5-five packs for \$20, 30 for \$99

## IS ANYBODY OUT RESOURCES UN-LTD. VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-\$10-4070 TECH: 603-668-2499 FAX: 403-644-7825 E-MAIL unitd4u@m20.net 300 BEDFORD STREET, MANCHESTER, NH 0310 SUPER, MINI C-MOUNT CAMERAS,

Super sensitive, GM410 or the general purpose GM412,

The GM-412 specs: B&W, size 1.5\*sq. X 2.4\*L, 250,000 Pixels, **380** Lines solution. Sensitivity 0.3 Lux. The GM410 specs: size only 1.5° SQ. x 1.6°L, >270,000 Pixels. 410 Lines Res., Sens. 0.05 LUX., Both cameras are 1/3° CCD with AGC & Electronic shutter, 12V

©110mA power. NTSC out. IR SENSITIVE, BNC video out, Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting. True

performance not hype! The cameras will outperform ANY camera in this magazine. Multilens options are available to exploi their superior performance.GM412 shown bottom. GM410 shown top. GM412, less lens..\$119. GM410, less lens..\$169

LIFE

fow cost MICRO CAMERA, w/audio 1/3\* CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 4mm, 78° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC rideo out, 1/2 ounce! SENSITIVE to IR. Size Std: 1.25'sq.x 1'd. PH is 0.6'd, 1.6M long wiring harness with connectors included. WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.

GM-1000A-STD......\$59 GM-1000A-STD/Aud.....\$64 GM-1000A-PH... ...\$59 GM-1000A-PH/Aud... GM-1000A-CMNT.\$59 GM-1000A-CMNT/Aud.\$64

Micro Lenses for GM1000 series ..\$22 2.5mm, 150°. 8.0mm, f2.0. 4.3mm, 78° f1.8.....\$22 12.0mm, f2.0... \$22 5mm, 70°PH. 6.0mm, f2.0... \$22 \$22

C-MOUNT LENSES

LOW LIGHT STANDARD 16mm, f1.6, 15° FOV .... 8mm, f1.3, 40° FOV .... 4mm, 80° FOV 8mm, 40° FOV \$39 4mm, fl.4, 78° FOV.

#### NEW, 2.4GHz VIDEO + STEREO AUDIO TRANSMITTER with SONY, CCM-PC5 COLOR CAMERA.



Originally sold for \$500! Now available for a fraction of that price. Great looking styling. Camera has a very stable, adjustable tiliting base front panel LED pwr indicator and sensitive built in electret mic, providing excellent audio and video

compact package. Simply connect camera to the ned 2.4GHz transmitter. All cables supplied. You letely self co can transmit up to 700 eet clear line of sight

Companion matchin receiver works with any TV or VCR. Intern patch antennas. Camera has adjustable focus 6mn

nacro capable) Auto power off when the p Power is 7-13VDC. (all pwr. adapters and cables included) 1/3° CCD, 330Lines res. 35% better than standard VHS! Can als be used to trans VCR oputput to another TV for remote v

2.4GHz SONY-ASTROVIEW....\$189ea. or 2 for \$339 addtl. 2.4GHz TRANSMITTER/RCVR. less Cam...\$129ea.

#### MOTORIZED ZOOM LENS SPECIAL

6X magnification, 12X on a 1/3" camera! Auto iris too! New, fabulous hi-res. optics with std. C-Mount. Superior Fujinon and Vicor lenses. Normally cost from \$600 to \$1500. There is no substitute for a good lens! All drive motors will operate from 6-12VDC. Auto iris has a built in amp which works with any cameras video output for control.

Type B-6, 12.5 to 75mm, 6X, f1.2 ...... ZOOM LENS CONTROLLER, NEW ...... \$179 or 2 for \$349

Brand New, Video Motion Sensor, Model VM10. Attach to any standard video signal and you've got an electronic "watchman" diligently watching the entire scene. Or any adjustable sized area within the scene. Such as a

doorway or even a drawer or cabinet A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac powered. NEW. VM10.....\$189ea.

#### MOTORIZED 10X ZOOM, SURVEILLANCE LENS



Adjustable sensitivity. Video loop through.

New, 11mm to 110mm, f1.8, C-Mount, Fujinon, industrial quality optics paired with precision drive enable smooth remote operation of FOCUS, ZOOM and IRIS. Unit is open frame, black anodized alum. structure supports the sophisticated drive. Two models: Mod Z5 std, or Mod Z10 has HP optical encoders for position feedback (128ppr) on zoom & focus Edmunds sells the lens w/o drive for \$869er Motorized unit sells for >\$2000, Very limited quantity.

Model Z5.....\$349ea. Model Z10.....\$399ea. New ZOOM LENS CONTROLLER... .\$169ea.

**NEW! 4 or 8 CHANNEL, SEQUENCER** 

odel GM34 or GM38. Connect to any four standard



video signals and they will be sequentially output to the dual rear panel BNC outputs. Front panel user adjustable, variable dwell 1 to 15 sec pe channel. Auto or manual switching with channel bypass. Compact only 8.6°W x 3.7° C x 1.75° H, ac powered. Video loop through. GM-34......\$79, GM-38......\$99



WEATHER RESISTANT Camera Enclosure, Solid, extruded aircraft aluminum. Glass window. Strain reliefs for cables. Size: 3.5°w x 3.7°h x14°L,

Special.\$59ea. w/110V heater..\$69ea. Heavy Duty Alum. Adj. Mount....\$29ea.



you could put this little ier

DAYLIGHT/LOW LIGHT MINI CAM & A/I LENS, For down 'till dusk applications. Rugged alum. housing, dual mtg. sockets. 1/3\* CCD. 420 lines res., 0.1 Lux sens., AGC, 12VDC @120mA. Take full advantage of camera sensitivity with super, 4mm, 11.4, 78° FOV Auto Iris Iens included. BNC video out. 50mm sq. X 65mml. Pow adapter included. GM-510A/1...\$199 or 2/\$369

Sleek black anodized, BRASS, housing. 0-Ring sealed & WATERPROOF, Adjustable mount incl. Specs: 1/3° CCD, 400 Lines res., 0.05 Lux sensitivity, AGC, Auto Shutter. 12VDC @225mA, 4mm, 78° FOV lens, A real glass lens. NTSC ideo out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25° diam. X. 2°

NOW YOU CAN SEE WHAT THE "FISHES ARE DOIN' (down 60 ft.)

UNDERWATER B&W CAMERA with

INTERNAL, INFRA-RED ILLUMINATOR!



here's no doubt that the development of the opamp has simplified audio design to the point where even beginners can get involved fairly early on.

Op-amps are a snap to use, difficult to damage, and give stable performance under a variety of conditions. And the literature on the subject is immense; there are no end of books and magazine articles explaining their use.

Unfortunately, most of these resources tend to treat only the "ideal opamp" and fail to take into account the real-world subtleties that lead to a polished design.

So, the purpose of this article is to fill in the gaps by showing you some of the op-amp techniques required for the design of high quality, low noise audio circuits. You'll find the basic formulas you need to get started, of course, in addition to a few not so well-known tricks.

We'll assume that you're already somewhat familiar with opamp basics. However, to make sure we're all starting from the same point, let's review two essential principles. First, an op-amp has two inputs and one output. The inputs are differential in nature; one of them inverts the incoming signal while the other one doesn't. Not surprisingly, these are called the inverting and non-inverting inputs, respectively. A signal appearing at the inverting input will be subtracted from the final mix, while that appearing at the non-inverting input will be added.

Next, as it comes off of the shelf, an op-amp has a huge amount of inherent gain when it runs open loop. But in the real world, a huge amount of gain means lots of headaches like selfoscillation, distortion, and noise. So one of the basic principles of opamp design is that, for stable performance, it is best to feed some of the output signal back around to the inverting input. Since we're now subtracting from the overall mix, this has the effect of reducing the gain to a more sensible figure.

The name given to this is "negative feedback." With these basic ideas in mind, then, let's turn to some practical circuits.

#### **VOLTAGE FOLLOWERS**

As you might suspect from an examination of Figure 1, the voltage follower is the simplest of opamp configurations. Recall from above that the signal fed back from the output to the inverting input lowers the gain of an amplifier. In this case, we have 100% feedback.

As the output tries to rise, the signal fed back to the inverting input pulls it back down again. The upshot is that the voltage follower has a gain of 1. That might seem like a useless feature until you look into what's happening to the current. While the voltage isn't amplified at all, the current is.

To put it another way, the output impedance is very low, typically below 100 ohms for most op-amps. Add to this the fact that the input impedance is gigantic (from several to many megohms for most opamps) and the purpose of the voltage follower becomes obvious: It's superb as a buffer. (Input impedance is abbreviated as "In Z" in all of the figures.)

In audio circuits, we use buffers to keep the input of one stage from loading down the output of the previous. Loading is definitely something we can do without; it leads to a drop in the high end response of an audio circuit, and attenuation in

There is a problem with Figure 1(a), however. With a gigantic input impedance, a wire leading up to the non-inverting input can act as an antenna for RF (radio frequency) signals. In some circumstances, you might actually detect a radio broadcast, but more likely you'll get some nasty distortion as the RF interacts with the audio signal.

The way to get around this is simple: Reduce the input impedance to a more sane level. Figure 1(b) shows how to do this. Since the outboard resistor parallels the inherent input impedance of the

op-amp (which is so much larger), for all practical purposes, the resulting impedance is just the resistance of

There are several factors you'll have to balance when choosing R for your voltage follower. First, if it's too small, then obviously you're losing the advantage of the buffer. Remember, a low input impedance can load down the previous stage. And if it's too large, you're back to the problem of RF interference. As a general rule of thumb for most audio circuits, values between 100K and 1M are about right, with 500K

## Audio Design With Op-Amps

by Thomas Henry

being a good choice to start with. (More about this later when we take up the topic of source resistance.) But there's another easy trick we can pull to minimize RF

Notice how capacitor C straddles R in Figure 1(b). This attenuates the signals above a certain frequency by dumping them to ground. The equation in the diagram gives the -3dB point, that is, the frequency in Hertz at which the signal starts to fall off at a more rapid clip.

In general, audio circuits need only pass signals lying between about 20Hz to 20KHz. So if we choose the -3dB point to be somewhat above this, say 33KHz or so, then we can be assured that all of the audio information will be passed while the supersonic garbage will be dispensed with.

Figure 2 shows an application for the voltage follower which is not so well known and yet is extremely handy. It's a blend control which can be used to mix two audio signals continuously in any desired proportion. This is the sort of thing you might need in a musical instrument amplifier, for instance, when you wish to combine the straight sound with a reverb effect.

The circuit performs very well, however, there are two points to keep in mind when using it. First,

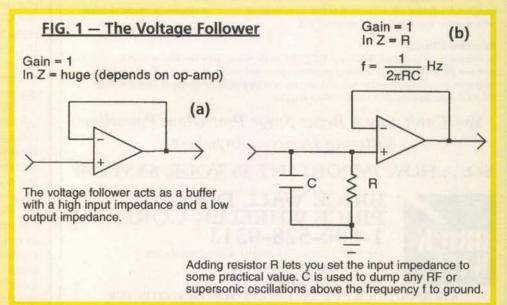
the two signals which are combined at the ends of the potentiometer must come from low impedance sources. Generally, you'll be mixing the outputs of two preceding opamp stages so that won't be a problem. Next, if the potentiometer is mounted on a front panel which is more than several inches away from the circuit board, then it is vital that shielded cabling be used.

The 500K pot represents a fairly high impedance (hence the need for a voltage follower to buffer it), and the wires connecting to it can pick up hum and interference unless shielded.

By the way, the shield of each wire should connect to ground at one end only, say on the circuit board side. This keeps you from getting into ground loop troubles which can be another potential source of hum.

#### THE NON-INVERTING AMPLIFIER

Figure 3 illustrates another useful op-amp configuration, the noninverting amplifier. Recall that with a voltage follower, there is 100% negative feedback which forces that circuit to have a gain of 1. But here the output is applied to a voltage divider comprising R2 and R3. Hence, only a portion of the output (tapped off of the tie point of the two resistors) is fed back to the



## Modern computing and standard surge suppressors... a recipe for disaster.

Almost all surge protection devices use MOV's (metal oxide varistors) as their active element. MOV's are sacrificial/wear/limited life components. Surge suppressors based on this technology are doomed to failure. These surge "suppressors" also don't suppress a thing. They divert powerline surges equally to the ground and neutral wire. When you put current on the common ground wire of interconnected equipment some of that current will flow (through the inherent ground loops) to the data lines. This is a major cause of lock-ups and misoperations that plague today's computer environments. Another fact; all modern computers use switch mode power supplies. During surges the power supply capacitors must charge to the clamping level of the MOV before the MOV turns on. A recent study has shown that it takes a 3000A surge 15 microseconds (15,000 nanoseconds) to charge the typical capacitors of these power supplies to that level. The surge is virtually over before the MOV reacts. (See five things you probably don't know about your surge suppressor at www.fivethings.com.)

THE POINT: Standard surge suppressors allow too much current to hit the computer. Standard surge suppressors divert surge current to the ground wire and disrupt data transfer. Standard surge suppressors eventually fail without warning. Modern computers have logic voltage levels (the signals that transmit the data) and power supply voltages that are dramatically lower than that of their recent predecessors. Modern computers use integrated circuits with transistors of ever decreasing physical geometries. Modern computers are virtually always interconnected to other computers or peripheral equipment. The bottom line; modern computers are much more sensitive and susceptible to powerline anomalies.

## The World's Best Surge Suppressor

Initially engineered for critical, non-fail industrial applications, this patented device protects indefinitely and sets a new standard for every measure of surge suppressor and powerline filtering performance.

A Brick Wall 1) Utilizes NO MOV'S or Any Other Sacrificial Components (a two pound inductor and nine capacitors are the heart of the unit) 2) Has No Joule Rating or Surge Current Limitations 3) HAS BEEN TESTED AND CERTIFIED BY UL TO THE MOST DEMANDING CLASSIFICATION OF A NEW GOVERNMENT SPECIFICATION; CLASS I, GRADE A. Which Means: UL PUT ONE THOUSAND 3000A, 6000V SURGES (this is the largest surge an interior environment can experience) THROUGH A UNIT (at 60 second intervals) AND DOCUMENTED NO FAIL-URE OR PERFORMANCE DEGRADATION OF ANY KIND WHATSOEVER...

#### i.e.: A Brick Wall Will Not Fail.

We know of no cord connected, MOV based surge protection device that has, or can pass this test.

A Brick Wall possesses UL's lowest Suppressed Voltage Rating (let-through voltage) of 330V. This is the lowest rating they will grant. In that test of one thousand 6000V, 3000A surges, UL NEVER SAWTHE LET-THROUGH VOLTAGE EXCEED 290V. YOU CANNOT DO BETTER THAN THIS FOR A POINT-OF-USE SURGE PROTECTION DEVICE. Once again, we know of no other surge protection device that could come close to this performance level.

A Brick Wall is a current activated Series Mode device. Since it is not wired in parallel, nor voltage activated, it does not have to wait for the capacitors of the power supply to charge before it becomes effective. YOUR EQUIPMENT IS PROTECTED INSTANTANEOUSLY (and indefinitely).

These devices were engineered utilizing a current limiting/surge filtering technology. THEY DO NOT DIVERT ANY SURGE CURRENT TO THE GROUND WIRE. They Will Not Cause Your Computer System To LOCK-UP, CRASH OR MISOPERATE as a consequence of surge diversion. Your current surge "suppressor" will.





Available in Modular Form

#### Powerline Filtering

In addition to all this, Brick Wall Surge FILTERS are the best AC powerline filters you can buy (that we have been able to find anyway). Industrial machinery, copiers, coffee makers, laser printers, fluorescent lights, refrigerators, etc., all cause powerline noise that can cause your computer to misoperate. A Brick Wall Surge Filter will make powerline noise related problems disappear.

You Can't Buy a Better Surge Protection/Powerline Filtering Device... Anywhere.

#### SO...HOW IMPORTANT IS YOUR SYSTEM?



BRICK WALL DIV., PRICE WHEELER CORP. 1-800-528-0313

Fax: 1-800-528-6623 E-Mail: info@brickwall.com Web: www.brickwall.com

Visa - MC - AMEX

ASK ABOUT OUR NEW IN-LINE UPS/SERVER PROTECTOR

inverting input. This lets us set the gain of the non-inverting amplifier to any value above unity, depending only on the ratio of R2 and R3. Figure 3(a) gives the required formula. Due to the fixed term of 1 in the equation, the gain can never be less than that value.

By the way, R1 is used to set the input impedance of the amplifier as before. We already know that choosing the value of this resistor balances good buffering against RF reception. But there is a third concern that we should look into right now.

In engineering terms, R1 is usually called the source resistance. It is a fact of physics that anytime current passes through a resistor, electrical noise is produced. The source resistance, of course, is connected to an amplifier with possibly high gain, and so the noise will also be boosted. Incidentally, some types of resistors (like carbon composition) are noisier than others.

It can be shown by simple experimentation that for bipolar opamps in general, a low source resistance gives the best noise performance. For example, with a 741 opamp, lowering the source resistance from 100K to 10K drops the noise amplitude by a factor of about four.

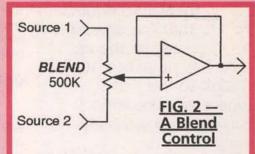
On the other hand, bifet opamps (like the TL071) are a trifle noisier than bipolar types, but only with low source resistances. In fact, the noise level barely rises as you move from 10K to 100K. This suggests a couple useful rules of thumb.

First, for low noise performance, it is generally best to keep the source resistance relatively low. Second, if you must have a high source resistance, switch over to a bifet type op-amp which gives much quieter performance than a bipolar type in this case.

We can apply what we've just learned to a really slick application sure to be popular with electric guitarists. See Figure 3(b). This is still a non-inverting amplifier whose gain is set by R2 and R3. But notice now how the input is fed directly by the guitar pickup, which is nothing more than a coil type transducer. (R1 is simply there to protect the op-amp from static electricity discharge and needn't figure into our discussion).

With this arrangement, we obtain an extremely low source resistance, on the order of several kilohms, since the pickup coil is merely a hank of wire. This brings the noise level down quite nicely, as discussed earlier.

But there are a couple other advantages to the approach taken in Figure 3(b). Since the pickup coil is applied directly to the op-amp (again, ignoring R1), we get the benefit of the non-inverting input's gigantic impedance. The buffering



The 500K potentiometer lets you pick off a continuously variable blend of Source 1 and Source 2. The voltage follower buffers this mix.

is as good as it gets here! The frequency response of this circuit will be excellent since loading is all but eliminated.

Finally, consider that most guitar gear of the past has been AC coupled; that is, the electric guitar signal passes through a capacitor, and then on to the preamplifier. But the direct connect method shown here avoids the cap altogether which leads to better phase and frequency response.

Before leaving this unusual application, observe that there is one condition which must be met for good performance. We've already noted that a long wire leading up to the non-inverting input of an op-amp can act as an antenna.

So, this suggests that the circuit is at its best when built literally right inside the electric guitar. This keeps the connection from the pick-up coil to the op-amp relatively short. And, of course, the connecting wire should be shielded, with the braid connecting to ground at one end only.

#### THE INVERTING AMPLIFIER

The inverting amplifier configuration is shown in Figure 4. In this circuit, the output will always be a mirror image of the input (positive becomes negative, and vice versa). As usual, the principle of negative feedback is used to adjust the gain as desired, obeying the formula shown in the diagram. Notice now that its value can be set less than 1 if desired (ignoring the sign change, of course). This is just one of the reasons why we frequently use the inverting amp in lieu of the non-inverting amp.

But another reason this configuration is so useful depends on a characteristic of the inverting input. Due to the internal components of the chip, the inverting input behaves as though it were sitting at ground potential. In fact, the term "virtual ground" is applied to it. This suggests that we can combine a variety of signals here; since they're all being driven through their respective resistors into what is apparently just a ground point, interaction is minimized. And that's exactly what we want from a mixer.

Figure 4(b) explains this. In this case, "n" different inputs are

applied to "n" separate resistors, respectively, and these are summed into the virtual ground of the inverting input. A mixed (and inverted) version is now available at the output. Notice that you can set the gain and input impedance for each source independently of the others.

When you're calculating the values of the resistors in a mixer, be sure to take into account what the largest possible output might be if all of the signals should max out at once. An opamp is typically powered by a bipolar supply, usually between 9V and 15V. And most op-amp outputs can only swing up to within a volt or two shy of the supply rails. So, to avoid distortion, make certain that your mix never bumps into either the plus or minus extremes. If it does, adjust the feedback resistor RF downward to lower the gain of the mixer.

#### BANDWIDTH LIMITING

We've already seen how to dump RF garbage to ground in the voltage follower. Let's generalize this now by taking up the subject of bandwidth limiting. The basic notion here is that if frequencies above and below the audio band contribute nothing to the overall sound, then why not get rid of them altogether. You might think attenuating frequencies beyond human hearing would have no discernible impact. For example, if radio signals of, say, 100KHz are running through your system, will you even notice them? As it turns out, RF garbage can, in fact, alias downward and corrupt audio signals, popping up again as distortion.

Another good reason for bandwidth limiting is that some types of op-amps can start to selfoscillate at super high frequencies under certain conditions. In fact, this is fairly common when a bifet type is driving a capacitive load. Under such circumstances, the chip starts to draw a hefty current and can even heat up to the point of being harmful to its health. By limiting the high end somewhat, we can stop this unwanted

behavior at once.

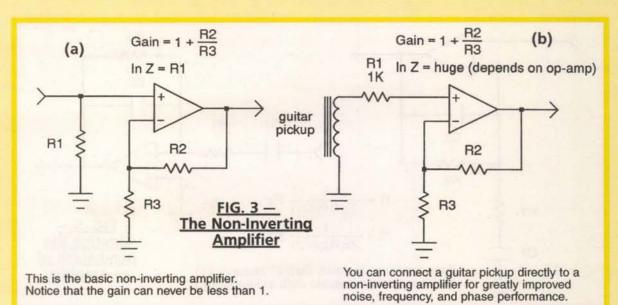
Figure 5 shows how to limit the low and high response of audio circuits built around op-

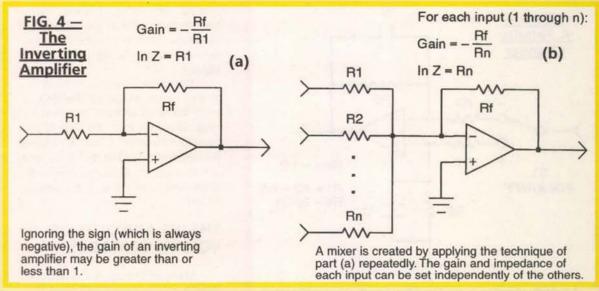
amps. The calculations are simple to do, and the formulas are easy to remember owing to their similarity. Best of all, they apply to both the inverting and non-inverting amplifiers. The formula for f1 determines the frequency where the bass response falls by -3dB. Similarly, the formula for f2 determines where the treble response falls off by -3dB.

Using these formulas, then, you could decide to limit the low response at 10Hz, say, and the high response at 33KHz, for example. The pass band is plenty wide enough to permit audio frequencies through, and yet narrow enough to reject any subsonic or supersonic rubbish.

#### A POLARITY CHANGER

Figure 6 shows a rather unusual circuit that is extremely useful in audio modification devices like phase shifters or analog delay units: a polarity changer. As the name suggests, its purpose is to either invert or not invert the input signal, depending on the switch setting. As it turns out, adding or subtracting a modified signal from the straight signal often leads to two very different sounds





The circuit is easy to understand, since it is really nothing more than a combination of the voltage follower and inverting amplifier already discussed. When S1 is in the "minus" position, then R1 simply floats, while R2 ties the noninverting input to ground. The signal passes

through R4 to the inverting input. As you can see, this is the inverting amplifier configuration. The ratio of R3 and R4 gives the gain, which is half since R3 is half the value of R4.

By flipping the switch to the "plus" position, R4 now floats, and R3 simply provides a 100%



Parallel Port Scope

**Environmental Logging** record temperature, humidity, etc.



\$79 - \$799

ADC Virtual Instruments turn your PC or laptop into a sophisticated storage scope AND spectrum analyzer AND multimeter. Display simultaneously on large screen! 100MS/s 8-bit or 1.2MS/s 12-bit or 333kS/s versions. Great for schools, test depts, etc. Input to Excel! LabView/NT drivers included.

\$129

ENVIROMON - temperature (thermistor), humidity & light sensors, door position, etc. Record for 365/24 without a PC even if power fails. Monitor 30 sensors 400 yds away. With cables and easy software. Remote audio alarm. Use TC-08 for most thermocouples.

osziFOX 20MS/s handheld scope



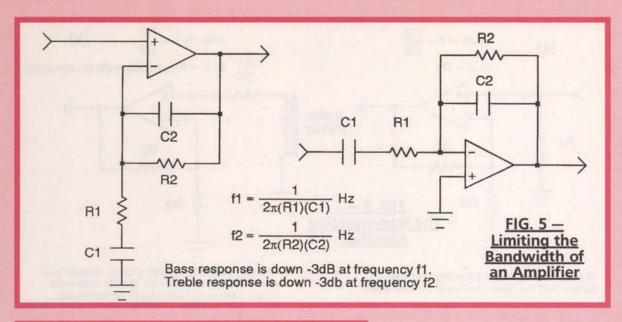
osziFOX - handheld storage scope and DVM - standalone or plugs into your PC for display, store-to-disk printing in color. Inputs to 100V, trigger, backlit LCD.

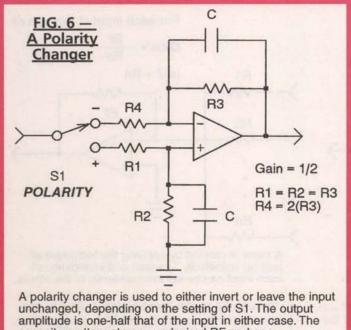
Download FREE demo software. Sales only: 1-888-7SAELIG

www.saelig.com 716-425-3753 • -3835 (fax) saelig@aol.com



Stocked in NY by Saelig Company: Virtual Instruments, I2C and embedded controllers, BITlink 2-v networks, RS232/422/485, frame grabbers, etc. See www.saelig.com for Product of the Month!





negative feedback loop. The input signal is dropped across the voltage divider comprising R1

capacitors attenuate any undesired RF garbage.

and R2. The voltage follower then buffers the signal at the tie point of these two resistors. Since the resistors are equal, the signal is again halved.

The three wires connecting S1 to this circuit should be shielded, with the braid of each attached to ground at one end only. The two capacitors labeled C help knock any RF nonsense dead in its tracks. Use the formula for f2 from Figure 5 to determine where the -3dB point is to be.

#### THE INS AND OUTS OF VOLUME CONTROLS

Many of the audio circuits you design with op-amps will need to have their gains tamed with a volume control of some sort. Believe it or not, even a simple feature like this involves a fair amount of subtle-

ty. Figure 7 shows four different approaches; let's examine them one-by-one.

As we've already seen, in an inverting amplifier, the smaller the feedback resistor, the less the gain (with the input resistor held fixed). Many beginners attempt to apply this fact by coming

up with the circuit in Figure 7(a).

Theoretically, there's nothing wrong with the method. But consider what could happen with a "real-world" potentiometer. Suppose the wiper loses contact with the resistive element in the pot (and this can happen depending on age and quality). All of a sudden, the op-amp is running open loop, with a gain of thousands! You might hear a single pop, or you might hear an uncontrolled roaring, depending on the rest of the circuit. In either case, your ears aren't going to like it! So we'll eschew this type of volume control as a general rule. Let's see some better ways of handling things.

Figures 7(b) and 7(c) show how to string up a pot on the front end of an amplifier. In the first, we buffer the wiper of the volume control with a voltage follower. R1's full range value becomes the input impedance and all of the previous considerations apply when selecting its value. As usual, we strap in C to attenuate any

potential RF interference.

In the case of the inverting amplifier of Figure 7(c), the input impedance varies depending both on the value and setting of the potentiometer and the value of R2. Things can get pretty tricky in short order since there's a parallel resistance effect going on and one of the resistors is continuously variable! (R1 provides a path to ground, and R2 provides a parallel path to a virtual ground).

However, there is a decent rule of thumb which will generally hold you in good stead: choose R2 to be 10 times the value of R1. Thus, the impact of R2 is minimized, and you can consider the input impedance to be simply the value of R1. But there's an even more important benefit to this choice and it has to do with the "feel" of the control. The response of a pot, called its taper, establishes this.

A linear taper potentiometer moves smoothly across all values from low to high in a straight line fashion. But an audio taper pot is logarithmic

> in nature and acts a little more quickly at the low end, while slowing down at the top. You select the taper of the potentiometer according to your application.

> Now, if R2 were equal to R1, say, then you'd get into that variable parallel resistance business mentioned above. The feel of the control would become distorted. Keeping resistor R2 large compared to R1 lessens the effect.

> By the way, this circuit makes a good front end for the mixer shown in Figure 4(b). For most audio work, choosing the pots to be 10K and the resistors to be 100K works quite well.

It is frequently the case that you'll want to control the volume of some final output stage just as the signal makes its exit to any outboard gear. Figure 7(d) shows how to do this. Notice that the capacitor precedes the output pot, and not the other way around. The reason for this is simple, but not all that obvious

If there should happen to be any DC bias riding on the signal as it leaves the op-amp, the capacitor will block it before it gets to the potentiometer. This helps reduce

#### REMOTE CONTROL SHOWDOWN TV A/B SWITCH







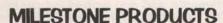
- HAS SEPARATE REMOTE FOR A/B
- MUST PLUG INTO AN A.C. OUTLET
- HAS EASILY DAMAGED R.F. RELAY
- A TO B ISOLATION IS MARGINAL
- POOR R.F. SHIELDING, CAN CAUSE DIAGONAL LINES IN TV PICTURE
- CONTROLLED BY EXISTING TV REMOTES
  - NO A.C., RUNS A FULL YEAR ON 2 "AA"s
  - 100% SOLID STATE, NOTHING TO BREAK
- EXCEPTIONALLY HIGH A TO B ISOLATION
- EXCELLENT R.F. SHIELDING, WILL NOT CAUSE INTERFERENCE IN TV PICTURE

QuikSwitch blows away the competition, both in quality and convenience! With its patented infrared receiver, QuikSwitch gives virtually any TV/VCR/ CABLE/SAT remote the power to switch between A & B video sources! Switching is accomplished simply by holding down any button on any infrared remote for 2 seconds. A button such as "0" or "STOP" is used, one that will be ignored by the TV/VCR/etc. QuikSwitch has bright red & green A/B indicators, and runs for a full year on 2 "AA" alkaline batteries (not included). No A.C. outlet needed! What's more, QuikSwitch is a top quality R.F. device, with exceptional immunity to crosstalk and signal leakage. Why would you buy any other A/B switch? Order your QuikSwitch now and save!

QUIKSWITCH

MasterCare

Shipping Charges Additional - 30 Day Money Back Guarantee - One Year Warranty



1-800-831-0184



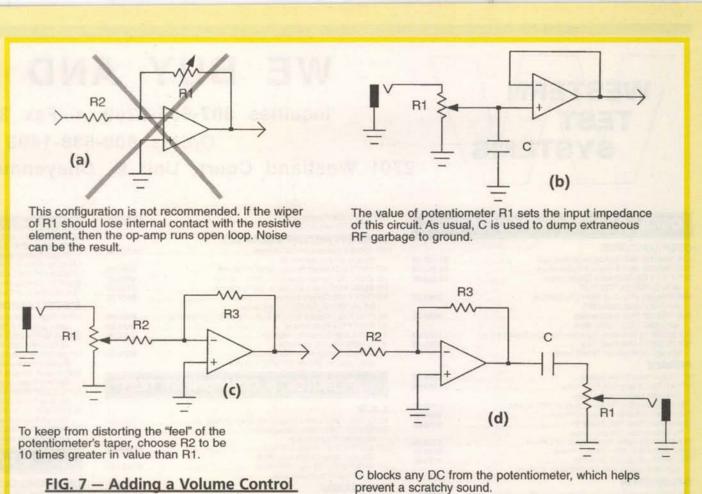
any scratchiness or pops as you spin the pot shaft.

Be sure to pick C large enough so that you don't limit the bass response unintentionally. For example, with a 10K potentiometer (a common value for audio circuits), C should be 2.2 mfd or even 10 mfd. This guarantees that the -3dB point is well under the lowest perceivable audio frequency. And the cap should probably be a nonpolarized electrolytic, unless you are certain of the polarity of any preceding DC bias.

#### THIS IS JUST THE START!

And there you have it, a collection of tips and ideas for designing your own low noise audio circuits with op-amps. Of course, there is much more to the subject, but this should provide you with a solid groundwork on which to build.

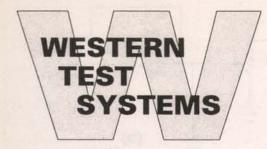
Naturally, you'll want to turn to other articles and books to increase your expertise. But perhaps, even more important, is the time you spend in the lab actually building and testing various devices. That's where you'll really start to get a feel for circuit actions. And if you learn from your experiences (keep a notebook!), you'll soon find yourself becoming quite a pro at audio design with op-amps. NV



ACKNOWLEDGMENT: Craig Anderton came up with the clever idea of interfacing an electric guitar pickup directly to the non-inverting input of an op-amp. He first described it in his article, "Low Noise Preamp Input Stage," which appeared in DEVICE Newsletter, Volume 1, Number 12, p. 11.1 want to thank Craig here for writing that and his countless other articles which have so greatly influenced all of us who love do-it-yourself audio projects.



to an Op-Amp Circuit



## WE BUY AND SELL

Inquiries 307-635-2269 • Fax 307-635-2291

Orders 800-538-1493

2701 Westland Court, Unit B, C

OSCILLOSCOPES & ACCESSO	DRIES	KEITHLEY 228 Programmable	\$1,900.00	HP 6237B Triple Output Supply, to +/-20 V 0.5 A & 0-18 V 1 A HP 6253A Dual 0-20 V 0-3 A CV/CC Power Supply	
		CURRENT METERS & SOURCES		HP 6255A Dual 0-40 V 0-1.5 A CV/CC Power Supply	\$450.00
OSCILLOSCOPES		HP 4140B Picoammeter / DC Voltage	\$2,000.00	KEPCO MPS-620M Triple	\$250.00
TEK 2445 150 MHz 4-channel Oscilloscope		Source, without test fixture HP 6177C DC Current Source, to 50 V, 500 mA	eroo oo	LAMBDA LPD-422-FM Dual 0-40 V 0-1 A CV/CC Power Supply	\$300.00
TEK 2465 300 MHz 4-channel Oscilloscope		HP 6181C DC Current Source, to 50 V, 500 mA		LAMBDA LPT-7202-FM Triple Output Power Supply	\$450.00
w/7A29.7A29-04.7B10.7B15	A THE RESIDENCE OF THE PARTY OF	HP 6186C DC Current Source, to 300 V, 100 mA	\$750.00	TEK PS5010 Programmable Triple Power Supply, TM5000 series TEK PS503A Dual Power Supply, TM500 series	
TEK 7844 400 MHz Dual Beam Oscilloscope		KEITHLEY 225 Current Source, 0.1 uA-100 mA, 10-100 V compliance	\$500.00	MISCELLANEOUS	
TEK 7904 500 MHz Oscilloscope,	\$900.00	KEITHLEY 227 Current Source, 1 uA-1 A, 0-50 V compliance	\$800.00	ACME PS2L-500 Programmable	\$350.00
with 7A24, 7A26, 7B80, 7B85		KEITHLEY 614 Electrometer	\$650.00	Load, 0-75 V / 0-75 A / 500 Watts max. ELGAR 501C/400SD AC Power Source,	
TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series TEK SC503 10 MHz Dual Trace		TEK CT-5 High Current Transformer	27 - 2	45 Hz-5 kHz 500 VA 0-135 VAC	
Storage Oscilloscope, TM500 series		TEK P6022 AC Current Probe	\$275.00	HP 59501B HPIB Isolated DAC/Power	\$175.00
PROBES		w/termination, 935 Hz-120 MHz, 6 A pk		Supply Programmer KEPCO BOP 20-20M Bipolar	0075.00
HP 1122A Probe Power Supply	\$150.00	IMPEDANCE & COMPONENT	TECT	Op Amp/Power Supply, to 20 V 20 A	\$675.00
HP 54701A 2.5 GHz 10X FET Probe, for 54700 series oscilloscopes	\$1,000.00	IMPEDANCE & COMPONENT	IESI	Op Amp/Power Supply, to 20 V 20 A KEPCO BOP 36-5M Bipolar	\$400.00
TEK 1101 Accessory Power Supply, for FET probes		L.C.R.		Op Amp/Power Supply, to 36 V 5 A KEPCO BOP 50-2M Bipolar	\$400.00
TEK P6046 100 MHz Differential Probe		BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH	\$550.00	Op Amp/Power Supply, to 50 V 2 A TRANSISTOR DEVICES DAL-50-15-100	\$400.00
TEK P6150 9 GHz 10X/ 3 GHz 1X 50 Ohm Probe, SMA(m) output	\$400.00	BOONTON 72BD 1 MHz Capacitance		TRANSISTOR DEVICES DAL-50-15-100	\$200.00
TEK P6201 900 MHz 1X/10X/100X FET Probe		Meter, 3-1/2 digit display HP 4262A-101 3-1/2 digit LCR Meter,	** ***	Programmable Load, 0-50 V, 0-15 A, 100 Watts max.	
TEK P6202A 500 MHz 10X FET Probe		120 Hz/ 1 kHz/ 10 kHz test HPIR		TIME & FREQUENCY	
TEK P6701-opt.02 O/E Converter,	\$175.00	HP 4275A-001 5-1/2 digit LCR Meter,	\$3,250.00	TIME & THEGOLIVET	
CALIBRATION		10 kHz-10 MHz, int./ext. bias		UNIVERSAL COUNTERS	
TEK SG503 Level Generator, 250 kHz-250 MHz, TM500 series	\$600.00	STANDARDS		HP 5314A-001 100 MHz/100 nS	\$275.00
A STATE OF THE PROPERTY OF THE		E.S.I. SR-1 Standard Resistor, various values			
WAVEFORM GENERATORS	S	Standards, 1 Ohm-100 K/step		HP 5315A-001 100 MHz/100 nS	
		E.S.I. SR1050-1M Resistance	\$2,000.00	HP 5315A-002 003 100 MHz/100 nS	\$650.00
FUNCTION		Transfer Standard, 1 Megohm/step GR 1404-A 1000 pF Reference Standard Capacitor	\$700.00	Univ. Counter; batt. power & 1 GHz C-ch. HP 5315A-003 100 MHz/100 nS	12-14-
HP 3312A 13 MHz Function Generator		GR 1406 Standard Air Capacitors,	\$375.00	HP 5315A-003 100 MHz/100 nS	\$550.00
HP 3314A-001 20 MHz Function Generator, HPIB		GR900 connector, 0.1% acc. GR 1432-U 4-Decade Resistor,		HP 5315B 100 MHz/ 100 nS Universal Counter	\$500.00
HP 3325A-002 21 MHz Synthesized		GR 1432-U 4-Decade Resistor, 0-111.10 Ohms, 0.01 Ohm resolution	\$100.00	HP 5316A 100 MHz/100 nS Universal Counter, HPIB	\$600.00
Function Generator, HV output option HP 8165A-002 Prog. Signal Source,		GR 1433-J 4-Decade Resistor,	\$150.00	HP 5316A-001,003 100 MHz/ 100 nS	\$750.00
1 mHz-50 MHz log sweep	\$1,250.00	0-11,110 Ohms, 1 Ohm resolution		HP 5316B 100 MHz/ 100 nS Universal Counter, HPIB	\$750.00
1 mHz-50 MHz, log sweep HP 8904A-001,002,004	\$2,500.00	GR 1433-K 4-Decade Resistor, 0-1,110 Ohms, 0.1 Ohm resolution	\$150.00	HP 5370B 100 MHz/ 20 pS 11	\$1,200.00
Multifunction Synthesizer, DC-600 kHz TEK AWG5102 Arb.Waveform Gen.,		GR 1433-L 4-Decade Resistor,	\$150.00	digit Universal Time Interval Counter PHILIPS PM6672/411 120 MHz/100 nS	9450.00
20 MS/c 12 hite 50nnm cunthagic <1MHz		0-111,100 Ohms, 10 Ohms resolution GR 1433-N 5-Decade Resistor,		Universal Counter C-channel 70-1000 MHz	
TEK AWG5105-opt.02 Arbitrary	\$1,250.00	0-11,111 Ohms, 0.1 Ohm resolution	\$200.00	TEK DC5004 Programmable 100 MHz/100nS	\$250.00
Waveform Generator, dual channel option TEK DD501 Digital Delay & Burst Gen.,	****	GR 1433-Y 6-Decade Resistor		Counter/Timer, TM5000 series TEK DC5009 Programmable 135 MHz	\$400.00
for function & pulse gen's	\$275.00	to 111,111.0 Ohms, 0.1 Ohm res.	\$250.00	Univ. Counter/Timer, TM5000 series TEK DC5010 350 MHz / 3.125 nS	9400.00
TEK FG501 1 MHz Function Generator, TM500 series		HI & LO RESISTANCE HP 4328A Milliohmeter			\$950.00
TEK FG502 11 MHz Function Generator, TM500 series TEK FG503 3 MHz Function Generator, TM500 series			\$1,200.00	Universal Counter, TM5000 series TEK DC503A 125 MHz/100 nS Universal	\$275.00
TEK RG501 Ramp Generator, TM500 series		T.D.R. TEK 1502-opt.04 Time Domain	** ***	Counter, TM500 series	
WAVETEK 288 20 MHz Synthesized	\$750.00	Reflectometer, 0-2,000 feet, chart recorder	\$1,400.00	TEK DC509 135 MHz/ 10 nS Universal Counter, TM500 series	\$275.00
Function Generator, GPIB		TEK 1503B-03,04 T.D.R., 0-50,000 ft.,		FREQUENCY COUNTERS	
PULSE BERKELEY NUCLEONICS 7085B	*****	chart recorder & battery power TEK 1503-opt.04 Time Domain	44 400 00	EIP 545A 18 GHz Frequency Counter	\$750.00
Digital Delay Generator, 0-100 mS, 1 nS res.,5 Hz-5 MHz	\$750.00	Reflectometer, 0-50,000 feet,chart recorder	\$1,400.00	batton names OCYO and see mult	THE REAL PROPERTY.
HP 214B 10 MHz 100 Vpk Pulse Generator				HP 5340A 18 GHz Frequency Counter	\$450.00
HP 8007B 100 MHz Pulse Generator		POWER SUPPLIES		HP 5342A 18 GHz Frequency Counter	\$3,500.00
HP 8080A/81A/83A/84A 300 MHz Word Generator				Counter OCYO reference	
HP 8080A/91A/92A/93A	\$950.00	SINGLE OUTPUT HP 6200B Dual Range Supply		HP S345A/5355A/5356B 26.5 GHz CW/Pulse Frequency Counter	\$3,500.00
GHz Single Channel Pulse Generator     HP 8112A 50 MHz Programmable Pulse Generator, HPIB	\$4,000,00	HP 62008 Dual Range Supply,	\$200.00	HP 5351B-001 26.5 GHz Frequency	\$4,250.00
HP 8115A 50 MHz Dual Channel Pulse Generator, HPIB	\$2,750.00	HP 6207B 0-160 V 0-200 mA CV/CC Power Supply	\$200.00	Country UDID OCVO reference	
HP 8116A 50 MHz Pulse / Function Generator, HPIB		HP 6256B 0-10 V 0-20 A CV/CC Power Supply	\$250.00	HP 5364A Microwave Mixer / Detector,	
HP 8116A-001 50 MHz Pulse /		HP 6263B 0-20 V 0-10 A CV/CC Power Supply		HP 5385A-004 1 GHz Frequency Counter,	\$800.00
TEK PG502 250 MHz Pulse	\$600.00	HP 6267B 0-40 V 0-10 A CV/CC Power Supply	\$550.00	HPIB; OCXO ref. osc. option	The state of the s
Generator, Tr<1nS, TM500 series TEK PG505 100 kHz Pulse Generator,	6975.00	HP 6269B-028 0-40 V 0-50 A CV/CC		STANDARDS	District Control
80 V neak TM500 series		Power Supply; 230 VAC line HP 6274B 0-60 V 0-15 A CV/CC Power Supply	\$650.00	HP 105B Quartz Oscillator,	
TEK PG508 50 MHz Pulse Generator, TM500 series	\$400.00	HP 6281A 0-7.5 V 0-5 A CV/CC Power Supply	\$150.00	0.1/ 1.0/ 5.0 MHz, battery power HP 5087A-opt.032 Distribution	\$1,750.00
WAVETEK 802 50 MHz Pulse Generator	\$300.00	HP 6282A 0-10 V 0-10 A CV/CC Power Supply	\$200.00	Amplifier, 12 outputs at 5 MHz	
VOLTAGE & GURDENT		HP 6289A 0-40 V 0-1.5 A CV/CC Power Supply	\$200.00		-
VOLTAGE & CURRENT	PLAIN.	HP 6384A 4.0-5.5 V at 8 A CV/CL Power Supply		AUDIO & BASEBAND	(Follow)
VOLTMETERS		HP 6443B 0-120 V 0-2.5 A CV/CC Power Supply	\$450.00	COLUMN TO SERVICE DE SERVICE DE SERVICE DE SERVICE DE LA COLUMN DE LA	
VOLTMETERS FLUKE 845AR High Impedance Voltmeter / Null Detector	P400.00	HP 6574A 0-60 V 0-35 A CV/CC Power Supply HP 6672A System DC Power Supply,	\$1,675.00	SPECTRUM ANALYSIS	
HP 3456A 6-1/2 Digit Voltmeter, HPIB		0-20 V 0-100 A CV/CC, HPIB	\$2,750.00	HP 3586C Selective Level Meter,	\$1,200.00
HP 3457A 7-1/2 digit Voltmeter, HPIB	\$1,200.00	KEPCO ATE 36-30M 0-36 V 0-30 A CV/CC Power Supply		TEK 7L5/L3/R7603 Spectrum Analyzer,	\$1,500.00
		KEPCO ATE 36-8M 0-36 V 0-8 A CV/CC Power SupplyLAMBDA LK-352-FM 0-60 V 0-15 A CV/CC Power Supply		20 Hz-5 MHz, 10 Hz min. res., w/frame	
HP 3478A 5-1/2 digit Multimeter, HPIB	2 6000 00	Lambon Lives I in 0 00 to 10 A OVICO Fower Supply		DISTORTION ANALYZERS	
		SORENSEN DCR 20-25B2 0-20 V	\$550.00		
HP 3478A 5-1/2 digit Multimeter, HPIB. KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in	\$3,250.00 \$300.00	SORENSEN DCR 20-25B2 0-20 V		HP 8903A-001 Audio Analyzer,	\$1,500.00
HP 3478A 5-1/2 digit Multimeter, HPIB. KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in.	\$3,250.00 \$300.00	SORENSEN DCR 20-25B2 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1 25A	\$400.00	20 Hz-100 kHz; rear panel input	\$1,500.00
HP 3478A 5-1/2 digit Multimeter, HPIB KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in CALIBRATION	\$3,250.00 \$300.00 \$225.00	SORENSEN DCR 20-25B2 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1.25A 0-300 V 0-1.25 A CV/CC Power Supply SORENSON DCR 600-0.75B2	\$400.00	20 Hz-100 kHz; rear panel input RMS VOLTMETERS	
HP 3478A 5-1/2 digit Multimeter, HPIB KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in CALIBRATION FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA	\$3,250,00 \$300.00 \$225.00	SORENSEN DCR 20-2582 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1,25A 0-300 V 0-1,25 A CV/CC Power Supply SORENSON DCR 600-0,75B2	\$400.00 \$550.00	20 Hz-100 kHz; rear panel input  RMS VOLTMETERS  FLUKE 8922A True RMS Voltmeter,	
HP 3478A 5-1/2 digit Multimeter, HPIB  KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter  TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in  TEK DM501A 4-1/2 digit Multimeter, TM5000 series plug-in  CALIBRATION  FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA  FLUKE 515A Portable Calibrator,  DC/AC/Obms [in 8, hattery powers]	\$3,250.00 \$300.00 \$225.00 \$450.00 \$900.00	SORENSEN DCR 20-2582 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1.25A 0-300 V 0-1.25 A CV/CC Power Supply SORENSON DCR 600-0.75B2 0-600 V 0-750 mA CV/CC Power Supply SORENSON DCR 600-1.58 0-600 V	\$400.00 \$550.00	20 Hz-100 kHz; rear panel input  RMS VOLTMETERS  FLUKE 8922A True RMS Voltmeter,  180 uV-700 V, 2 Hz-11 MHz	
HP 3478A 5-1/2 digit Multimeter, HPIB KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in CALIBRATION FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power FLUKE 5220A Transconductance	\$3,250.00 \$300.00 \$225.00 \$450.00 \$900.00 \$3,000.00	SORENSEN DCR 20-25B2 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1 25A 0-300 V 0-1.25 A CV/CC Power Supply SORENSON DCR 600-0.75B2 0-600 V 0-750 mA CV/CC Power Supply SORENSON DCR 600-1.58 0-600 V 0-1.5 A CV/CC Power Supply SORENSON DCR 500-12 0-20 V 0-12 A CV/CC Power Supply	\$400.00 \$550.00 \$700.00 \$400.00	20 Hz-100 kHz; rear panel input  RMS VOLTMETERS  FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz  OSCILLATORS  HP 3336C Synthesizer / Level Generator, 10 Hz-21 MHz	\$450.00
HP 3478A 5-1/2 digit Multimeter, HPIB KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in CALIBRATION FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power FLUKE 5220A Transconductance	\$3,250.00 \$300.00 \$225.00 \$450.00 \$900.00 \$3,000.00	SORENSEN DCR 20-2582 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1.25A 0-300 V 0-1.25 A CV/CC Power Supply SORENSON DCR 600-0.75B2 0-600 V 0-750 PM CV/CC Power Supply SORENSON DCR 600-1.58 0-600 V 0-1.5 A CV/CC Power Supply SORENSON SRL 20-12 0-20 V 0-12 A CV/CC Power Supply SORENSON SRL 60-8 0-60 V 0-8 A CV/CC Power Supply	\$400.00 \$550.00 \$700.00 \$400.00 \$600.00	20 Hz-100 kHz; rear panel input  RMS VOLTMETERS  FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz  OSCILLATORS  HP 3336C Synthesizer / Level Generator, 10 Hz-21 MHz  TEK SG502 Sine/Square Osc.	\$450.00
HP 3478A 5-1/2 digit Multimeter, HPIB KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in CALIBRATION FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power FLUKE 5220A Transconductance	\$3,250.00 \$300.00 \$225.00 \$450.00 \$900.00 \$3,000.00	SORENSEN DCR 20-25B2 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1,25A 0-300 V 0-1,25 A CV/CC Power Supply SORENSON DCR 600-0,75B2 0-600 V 0-750 mA CV/CC Power Supply SORENSON DCR 600-1,5B 0-600 V 0-1.5 A CV/CC Power Supply SORENSON SRL 20-12 0-20 V 0-12 A CV/CC Power Supply SORENSON SRL 60-8 0-60 V 0-8 A CV/CC Power Supply TEK PS501-1 Power Supply	\$400.00 \$550.00 \$700.00 \$400.00 \$600.00	20 Hz-100 kHz; rear panel input  RMS VOLTMETERS  FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz  OSCILLATORS  HP 3336C Synthesizer / Level Generator, 10 Hz-21 MHz  TEK SG502 Sine/Square Osc., 5 Hz-500 kHz, 70 dB step atten.,TM500	\$450.00
HP 3478A 5-1/2 digit Multimeter, HPIB KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in TELWE 510A AC Reference Standard, 10 VRMS, 0-10 mA FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A VALHALLA 2703 AC Volt. Std. 0-120V/10 Hz-100 kHz;120-1200V/10 Hz-1 kHz	\$3,250.00 \$300.00 \$225.00 \$450.00 \$900.00 \$3,000.00 \$1,500.00	SORENSEN DCR 20-2582 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1,25A 0-300 V 0-1,25 A CV/CC Power Supply SORENSON DCR 600-0,75B2 0-600 V 0-750 mA CV/CC Power Supply SORENSON DCR 600-1,5B 0-600 V 0-1.5 A CV/CC Power Supply SORENSON SRL 20-12 0-20 V 0-12 A CV/CC Power Supply SORENSON SRL 60-8 0-60 V 0-8 A CV/CC Power Supply SORENSON SRL 60-8 0-60 V 0-8 A CV/CC Power Supply TEK PS501-1 Power Supply. 0-20 V, 2 mV res., 400 mA, TM500 series	\$400.00 \$550.00 \$700.00 \$400.00 \$600.00	20 Hz-100 kHz; rear panel input  RMS VOLTMETERS  FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz  OSCILLATORS  HP 3336C Synthesizer / Level Generator, 10 Hz-21 MHz  TEK SG502 Sine/Square Osc, 5 Hz-500 kHz, 70 dB step atten.,TM500  MISCELLANEOUS	\$450.00 \$1,000.00 \$200.00
HP 3478A 5-1/2 digit Multimeter, HPIB KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in TELVICE 510A AC Reference Standard, 10 VRMS, 0-10 mA FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A VALHALLA 2703 AC Volt.Std. 0-120V/10 Hz-100 kHz;120-1200V/10 Hz-1 kHz VOLTAGE SOURCES HP 6114A Precision Dual	\$3,250.00 \$300.00 \$225.00 \$450.00 \$900.00 \$3,000.00 \$1,500.00	SORENSEN DCR 20-2582 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1.25A 0-300 V 0-1.25 A CV/CC Power Supply SORENSON DCR 600-0.75B2 0-600 V 0-750 PM CV/CC Power Supply SORENSON DCR 600-1.5B 0-600 V 0-1.5 A CV/CC Power Supply SORENSON DCR 600-1.5B 0-600 V 0-1.5 A CV/CC Power Supply SORENSON SRL 20-12 0-20 V 0-12 A CV/CC Power Supply SORENSON SRL 60-8 0-60 V 0-8 A CV/CC Power Supply TEK PS501-1 Power Supply, 0-20 V, 2 mV res., 400 mA, TM500 series  MULTIPLE OUPULT	\$400.00 \$550.00 \$700.00 \$400.00 \$600.00 \$175.00	20 Hz-100 kHz; rear panel input  RMS VOLTMETERS  FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz  OSCILLATORS  HP 3336C Synthesizer / Level Generator, 10 Hz-21 MHz TEK SG502 Sine/Square Osc, 5 Hz-500 kHz, 70 dB step atten.,TM500  MISCELLANEOUS  HP 3575A-002 Phase-Gain Meter, 1 Hz-13 MHz, dual display	\$450.00 \$1,000.00 \$200.00
HP 3478A 5-1/2 digit Multimeter, HPIB KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIE SOLARTRON 7081 8-1/2 digit Voltmeter TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in TELWE 510A AC Reference Standard, 10 VRMS, 0-10 mA FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A VALHALLA 2703 AC Volt. Std. 0-120V/10 Hz-100 kHz;120-1200V/10 Hz-1 kHz	\$3,250.00 \$300.00 \$225.00 \$450.00 \$900.00 \$3,000.00 \$1,500.00	SORENSEN DCR 20-2582 0-20 V 0-25 A CV/CC Power Supply SORENSON DCR 300-1,25A 0-300 V 0-1,25 A CV/CC Power Supply SORENSON DCR 600-0,75B2 0-600 V 0-750 mA CV/CC Power Supply SORENSON DCR 600-1,5B 0-600 V 0-1.5 A CV/CC Power Supply SORENSON SRL 20-12 0-20 V 0-12 A CV/CC Power Supply SORENSON SRL 60-8 0-60 V 0-8 A CV/CC Power Supply SORENSON SRL 60-8 0-60 V 0-8 A CV/CC Power Supply TEK PS501-1 Power Supply. 0-20 V, 2 mV res., 400 mA, TM500 series	\$400.00 \$550.00 \$700.00 \$400.00 \$600.00 \$175.00	20 Hz-100 kHz; rear panel input  RMS VOLTMETERS  FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz  OSCILLATORS  HP 3336C Synthesizer / Level Generator, 10 Hz-21 MHz  TEK SG502 Sine/Square Osc, 5 Hz-500 kHz, 70 dB step atten.,TM500  MISCELLANEOUS	\$450.00 \$1,000.00 \$200.00 \$850.00 \$350.00

Cheyenne, Wyomin	ig 82001
HP 6237B Triple Output Supply, to +/-20 V 0.5 A 8	0.19.1.1.4
HP 6253A Dual 0-20 V 0-3 A CV/CC Power Supp HP 6255A Dual 0-40 V 0-1.5 A CV/CC Power Supp	ly\$450.00
KEPCO MPS-620M Triple	\$250.00
Output Supply, dual 0-20V 1A tracking & 0-6V LAMBDA LPD-422-FM Dual 0-40 V 0-1 A CV/CC	
LAMBDA LPT-7202-FM Triple Output Power Supp TEK PS5010 Programmable Triple Power Supply,	ly\$450.00
TEK PS503A Dual Power Supply, TM500 series	\$200.00
MISCELLANEOUS ACME PS2L-500 Programmable	#2E0.00
Load, 0-75 V / 0-75 A / 500 Watts max. ELGAR 501C/400SD AC Power Source,	\$350.0
45 Hz-5 LHz 500 VA 0-135 VAC	
HP 59501B HPIB Isolated DAC/PowerSupply Programmer	
KEPCO BOP 20-20M Bipolar Op Amp/Power Supply, to 20 V 20 A	\$675.00
KEPCO BOP 36-5M Bipolar	\$400.00
Op Amp/Power Supply, to 36 V 5 A KEPCO BOP 50-2M Bipolar	\$400.0
Op Amp/Power Supply, to 50 V 2 A TRANSISTOR DEVICES DAL-50-15-100	
Programmable Load, 0-50 V, 0-15 A, 100 Watt	s max.
TIME & FREQU	ENCY
UNIVERSAL COUNTERS	
HP 5314A-001 100 MHz/100 nS Universal Counter; TCXO reference option	\$275.0
HP 5315A-001 100 MHz/100 nS	\$450.0
Universal Counter, TCXO reference option HP 5315A-002,003 100 MHz/100 nS	\$650.0
Univ. Counter; batt. power & 1 GHz C-ch. HP 5315A-003 100 MHz/100 nS	\$550.0
Univ. Counter, 1 GHz C-channel option HP 5315B 100 MHz/ 100 nS Universal Counter	
HP 5316A 100 MHz/100 nS Universal Counter, H	PIB \$600.0
HP 5316A-001,003 100 MHz/ 100 nS Univ. Counter, HPIB, TCXO, 1 GHz C-ch.	
HP 5316B 100 MHz/ 100 nS Universal Counter, HP 5370B 100 MHz/ 20 pS 11	1PIB\$750.0
HP 5370B 100 MHz/ 20 pS 11	\$450.0
Universal Counter, C-channel 70-1000 MHz TEK DC5004 Programmable 100 MHz/100nS	
Counter/Timer TM5000 cories	
TEK DC5009 Programmable 135 MHz Univ. Counter/Timer, TM5000 series	\$400.0
Univ. Counter/Timer, TM5000 series TEK DC5010 350 MHz / 3.125 nS	\$950.0
Universal Counter, TM5000 series TEK DC503A 125 MHz/100 nS Universal	\$275.0
Counter, TM500 series TEK DC509 135 MHz/ 10 nS Universal Counter,	TM500 series \$275.0
FREQUENCY COUNTERS	
EIP 545A 18 GHz Frequency Counter FLUKE 7220A-010,131,351 1.3 GHz Counter;	\$750.0 \$500.0
battery power, OCXO, and res. mult. HP 5340A 18 GHz Frequency Counter	
HP 5342A 18 GHz Frequency Counter	\$1,250.0
HP 5343A-001 26.5 GHz Frequency Counter, OCXO reference	
HP 5345A/5355A/5356B 26.5 GHz CW/Pulse Frequency Counter	
HP 5351B-001 26.5 GHz Frequency	\$4,250.0
Counter, HPIB, OCXO reference HP 5364A Microwave Mixer / Detector,	\$3,000.0
for modulation domain an. HP 5385A-004 1 GHz Frequency Counter,	\$800.0
HPIB; OCXO ref. osc. option	
STANDARDS HP 105B Quartz Oscillator,	\$1,500.0
0.1/ 1.0/ 5.0 MHz, battery power HP 5087A-opt.032 Distribution	
Amplifier, 12 outputs at 5 MHz	***************************************
AUDIO & BASE	BAND
SPECTRUM ANALYSIS	
HP 3586C Selective Level Meter,	\$1,200.0
TEK 7L5/L3/R7603 Spectrum Analyzer,	\$1,500.0
20 Hz-5 MHz, 10 Hz min. res.,w/frame DISTORTION ANALYZERS	
HP 8903A-001 Audio Analyzer	\$1,500.0
20 Hz-100 kHz; rear panel input	
RMS VOLTMETERS FLUKE 8922A True RMS Voltmeter,	\$450.0
180 uV-700 V, 2 Hz-11 MHz	
OSCILLATORS  HP 3336C Synthesizer / Level Generator, 10 Hz-	21 MHz \$1,000.0
TEK SG502 Sine/Square Osc.,	\$200.0
5 Hz-500 kHz, 70 dB step atten.,TM500 MISCELLANEOUS	
HP 3575A-002 Phase-Gain Meter, 1 Hz-13 MHz,	
Pass Filter, 10 Hz-3 MHz, 24 dB/octave	\$350.0
VDOUN LITE 2202 Duel UD/I D/DD/DD Eller	\$450.0



#### 90 DAY WARRANTY PARTS AND LABOR • 10 DAY INSPECTION TEST EQUIPMENT WANTED CALL OR FAX LIST . OPEN ACCOUNTS



Marie Company of the	
WAVETEK 716 Brickwall Filter	\$1,500.00
0.1 Hz-1 MHz, TM500 series	
TEK AM502 Differential Amplifier,	\$475.00
Lowpass Filter, 0.1 Hz-111 kHz	
ROCKLAND 852 Dual Highpass/	\$900.00
0.001 Hz-99.9 kHz, 48 dB/octave	
KROHN-HITE 3342R Dual HP/LP Filter,	\$900.00

0.1 Hz-1 MHz, TM500 series WAVETEK 716 Brickwall Filter	\$1,500.00
RF & MICROWAVE	N.
SPECTRUM ANALYZERS	
HP 11517A/18A/19A/20A Mixer	\$500.00
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz	\$1,100.00
HP 11970K WR42 Harmonic Mixer, 18.0-26.5 GHz HP 11970Q WR22 Harmonic Mixer, 33-50 GHz	\$1,100.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz	\$1,400.00
HP 8559A/853A-001 Spectrum An.,	
0.01-21 GHz, 1 kHz res.,w/rackmount frame HP 8565A-100 Spectrum Analyzer,	\$3,250.00
10 MHz-22 GHz, 100 Hz min, res.	M.S. S.
HP 8568B Spectrum Analyzer, 100 Hz-1.5 GHz, 10 Hz min. res.	
HP 8569B Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min.res.bw.	
TEK TR502 Tracking Generator, 0.1-1800 MHz, for 7L13/7L14	\$950.00
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz	\$1,500.00
NETWORK ANALYZERS	
HP 11650A Network Analyzer Accessory Kit, APC7	\$600.00
Transmission Test Kit, 5 Hz-200 MHz HP 85020A Directional Bridge, 10-4300 MHz, N(f) test port	
HP 85027C Directional Bridge, 0.01-18 GHz, N(f) test port	\$1,750.00
HP 85054A Type N Calibration Kit, for HP 8510 series	
HP R85026A WR28 Detector, 26.5-40 GHz, for HP 8757 series	
WILTRON 560-98KF50 SWR Autotester,	\$1,800.00
10 MHz-40 GHz, for Wiltron 560 series	
SIGNAL GENERATORS FLUKE 6060A Synthesized Signal Gen.,	\$1,900.00
0.1-1050 MHz, 10 Hz res., GPIB FLUKE 6060A/AN Synthesized Signal Gen.,	
10 kHz-520 MHz 10 Hz res GPIB	
FLUKE 6060B/AK Synthesized Signal Gen., 0.1-1050 MHz, 10 Hz res.	
GIGATRONICS 1018 Synthesized Signal	\$4,500.00
Gen., 50 MHz-18 GHz, 1 MHz res. GIGATRONICS 600/6-12 Synthesized	\$2,500.00
Source, 6-12 GHz, 1 kHz res., GPIB GIGATRONICS 840-18 Freq. Multiplier,	
18-26 & 26-40 GHz outputs 0 dBm GIGATRONICS 875/50 Levelled Multiplier,	
x4, 50.0-75.0 GHz output, -3 dBm GIGATRONICS 875/86 Levelled	\$2,500.00
GIGATRONICS 875/86 Levelled	\$3,750.00
GIGATRONICS 900/2-8 Synthesized	\$2,500.00
Signal/Sweep Gen., 2-8 GHz, 1 MHz res.,GPIB HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio	\$450.00
HP 85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm	\$3,750.00
HP 8640B Signal Generator,	\$950.00
0.5-512 MHz, AM, FM, pulse modulation HP 8656B-001 Synth, Signal Gen.,	\$2,500.00
0.1-990 MHz, 10 Hz res., OCXO ref. HP 8657A-002 Signal Generator,	\$3,250.00
0.1-1040 MHz, 10 Hz res., HPIB HP 8660C/86602B-002 Synth. Sig. Gen.,	
1-1300 MHz, FM / Phase mod. w/86635A	
HP 8660C/86603A/86633B Synthesizer, 1-2600 MHz, 1 Hz res., AM / FM	
HP 8660D/86603A/86632B Synthesizer, 1-2600 MHz, 1 Hz res., AM / FM	\$4,500.00
HP 8672A Synthesized Signal	56.000.00
Generator, 2-18 GHz, +3 dBm output HP 8673D-H16 Synth Signal	\$18,500.00
Generator, 50 MHz-26 GHz, AM/FM	
HP 8673E Synthesized Signal	
HP 8673G-004,008 Synth. CW Signal	\$12,500.00
HP 8684B Signal Generator, 5.4-12.5 GHz, AM/ WBFM/ Pulse	\$3,500.00
SWEEP GENERATORS HP 83418-004 Synthesized Sweeper,	e14 500 00
10 MHz-20 GHz, +10 dBm;rear output	A TEN CONTRACTOR
HP 8350A/83545A-002 Sweep Oscillator,	\$4,000.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled	\$400.00
HP 8620C Sweep Oscillator Frame HP 86222B-002 RF Plug-in,	\$1,250.00
10-2400 MHz, +13 dBm levelled, 70 dB atten. HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled	\$375.00
HP 86240C RF Plug-in, 3.6-8.6 GHz, +16 dBm levelled HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled	\$700.00
HP 86242D-004.008 RF Plug-In, 5.9-9.0 GHz, +10 dBm levelled	\$300.00
HP 86245A-001 RF Plug-in, 5.9-12.4 GHz, +17 dBm levelled HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled	\$600.00
HP 86260A-H04 RF Plug-in,	
10.0-15.0 GHz, +10 dBm unlevelled HP 86290A-004 RF Plug-In,	\$1,750.00
2.0-18.0 GHz, +7 dBm levelled, rear output HP 86290B-004 RF Plug-in,	\$1,850.00
HP 86290B-004 RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled, rear output WAVETEK 962 Sweep Generator,	£1 250 00
1.0-4.0 GHz, markers, +12 dBm unlyld.	
WILTRON 6647M Sweep Generator, 10 MHz-20 GHz, +10 dBm levelled	\$4,500.00

POWER METERS	
ANRITSU MP-81B/ML-83A	\$2,500.00
Power Meter, 75-110 GHz (WR10), -20 to +20 dBm	
BOONTON 42B/41-4E Analog Power Meter,	\$450.00
with 1 MHz-18 GHz sensor	
HP 435B/8481A Power Meter,	\$900.00
-30 to +20 dBm, 10 MHz-18 GHz	
HP 435B/8481B Power Meter,	\$1,500.00
0 to +43 dBm, 10 MHz-18 GHz	
HP 435B/8482H Power Meter,	\$900.00
-10 to +34 dBm, 100 kHz-4.2 GHz	SALTE SALTE SALTE
HP 436A-022/8481A Power	\$1,400.00
Meter, -30 to +20 dBm, 10 MHz-18 GHz, HPiB	
HP 8477A Power Meter Calibrator, for HP 432 series	
HP 8900D/84811A Digital Peak	\$2,300.00
Power Meter, 10 MHz-18 GHz, 0- +20 dBm	
HP K486A WR42 Thermistor Mount,	\$350.00
18.0-26.5 GHz, for 432 series	** *** ***
HP Q8486A Power Sensor,	\$1,500.00
33.0-50.0 GHz, WR22, for 435/6/7/8	****
HP R486A WR28 Thermistor	\$350.00
Mount, 26.5-40 GHz, for 432 series	** ***
HP R8486A WR28 Power Sensor,	\$1,500.00
그, 그리지 않아 한 경기에 되었다면 하는 것이 뭐라면 하는데	
RF MILLIVOLTMETERS	
RACAL 9303 TRMS Level Meter,	\$875.00
10 kHz-2 GHz, -77 to +23 dBm, GPIB	
AMPLIFIERS, MISCELLANEOUS	
ENI 1040L Amplifier, 55 dB gain, 10-500 kHz, 400 Watts	\$2,750.00
HP 415E SWR Meter	\$200.00
HP 465A Amplifier, 20/40 dB,	\$125.00
5 Hz-1 MHz, 1/2 Watt/50 Ohms	
HP 8406A Comb Generator,	\$500.00
1/ 10/ 100 MHz increments, to 5 GHz	
HP 8447A Amplifier, 20 dB,	\$375.00
0.1-400 MHz, 5 dB NF, +6 dBm output	
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output	
HP 8447F-H64 Dual Amp.,	\$900.00
25 dBG 0.1-1300 MHz & 28 dBG 9 kHz-50 MHz	
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz	
HP 8901B-1,2,3 Modulation An.,	\$3,000.00
0.15-1300 MHz, rear input, OCXO, ext.LO	
HP 8970A Noise Figure Meter	\$4,000.00
ROHDE & SCHWARTZ	\$5,000.00
ESH2 Test Receiver, 9 kHz-30 MHz	
	Annual Property lies
COAXIAL & WAVEGUIDE	

ESHZ lest Heceiver, 9 KHZ-30 MHZ	
COAXIAL & WAVEGUIDE	
AMERICAN NUCLEONICS AM-432 Cavity Backed Spiral Antenna, LHC, 2-18 GHz, TNC(t) *NEW*	\$95.00
AVANTEK AMT-400X2 WR28	\$450.00
Active Doubler, 13-20 GHz +10 dBm in, +10 dBm out	
BAYTRON 3-28-300/10 WR28 Directional Coupler, 10 dB, 26.5-40 GHz	
Directional Coupler, 10 dB, 26.5-40 GHz BIRD 6735-300 1 kW Load,	\$650.00
25-1000 MHz, LC(I), with wattmeter	
BIRD 8201 500 Watt Oil Cooled Load, DC-2.5 GHz, N(f)	
CONTINENTAL MW. RAE28-K-M WR28 x K(m) Endlire Adapter	
FXR/MICROLAB S3-02N Triple	\$125.00
Stub Tuner, 200-1000 MHz, 100 Watts max., N(m/f) FXR/MICROLAB SL-03N Stub	
FXH/MICHOLAB SL-03N Stub	\$75.00
Tuner, 0.3-6.0 GHz, 100 Watts max., N(m/f) GR 874-LTL Constant Impedance	\$400.00
Trombone Line, 0-44 cm, DC-2 GHz	
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7	\$450.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz	\$800.00
HP 33321K Programmable	\$475.00
Step Atten., 0-70 dB, DC-26.5 GHz, 3.5mm HP 33327L-006 Programmable	
HP 33327L-006 Programmable Step Attenuator, 0-70 dB, DC-40 GHz, 2.9mm	\$1,000.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz	\$275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz	\$275.00
HP 778D-011 Dual Dir. Coupler,	\$450.00
20 dB, 100-2000 MHz, APC7 test port HP 8431A 2-4 GHz Band Pass Filter, N(m/l)	\$150.00
HP 8472A Crystal Detector, 10 MHz-18 GHz, negative polarity, SMA	
HP 8494G-002 Programmable Step	\$350.00
Attenuator, 0-11 dB, DC-4 GHz, SMA HP 8495H-002 Programmable Step	6400.00
Attenuator, 0-70 dB, DC-18 GHz, SMA	\$400.00
HP 8496A-002 Step Attenuator, 0-110 dB, DC-4 GHz, SMA	\$375.00
HP 8497K-004 Programmable Step	
Attenuator, 0-90 dB, DC-26.5 GHz HP K382A WR42 Direct Reading	
Attenuator, 0-50 dB, 18-26.5 GHz	
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz	
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz	
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz	
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz	
HP R422A WR28 Crystal Detector, 26.5-40 GHz	
HP R532A WR28 Frequency Meter, 26.5-40 GHz	\$500.00
HP R752C WR28 Directional Coupler, 10 dB, 26.5-40 GHz HP R752D WR28 Directional Coupler, 20 dB, 26.5-40 GHz	\$450.00
HP R914B WR28 Moving Load, 26.5-40 GHz	\$250.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz	\$750.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz	\$650.00
HP X870A WR90 Slide Screw Tuner HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz	\$150.00
HUGHES 45714H-1000 WR15 Frequency Meter, 50-75 GHz	\$900.00
HUGHES 45716H-1000 WR10 Frequency Meter, 75-110 GHz	\$900.00
HUGHES 45721H-1000 WR28 Direct Reading Attenuator, 0-50 dB, 26,5-40 GHz	\$900.00
HUGHES 45724H-1000 WR15 Direct Reading	\$1,000.00
Attenuator, 0-50 dB, 50-75 GHz	
HUGHES 45732H-1200 WR22 Level	\$250.00
Set Attenuator, 0-25 dB, 33-50 GHz	

HUGHES 45772H-1100 WR22	\$400.00
Thermistor Mount20 to +10 dBm. 33-50 GHz	3400.00
Thermistor Mount, -20 to +10 dBm, 33-50 GHz HUGHES 45773H-1100 WR19	\$650.00
Thermistor Mount, -20 to +10 dBm, 40-60 GHz HUGHES 45774H-1100 WR15	
HUGHES 45774H-1100 WR15	\$750.00
Thermistor Mount, -20 to +10 dBm, 50-75 GHz HUGHES 45775H-1100 WR12	\$800.00
Thermistor Mount20 to +10 dBm. 60-90 GHz	\$600.00
Thermistor Mount, -20 to +10 dBm, 60-90 GHz HUGHES 45776H-1100 WR10	\$850.00
Thermistor Mount, -20 to +10 dBm, 75-110 GHz HUGHES 47316H-1111 WR10	
HUGHES 47316H-1111 WR10	\$600.00
Tuneable Detector, 75-110 GHz, positive polarity HUGHES 47741H-2310 WR28	*** **** ***
Phase Locked Gunn Osc., 32.000 GHz, +18 dBm	\$2,000.00
HUGHES 47742H-1210 WR22	\$2,750.00
Phase Locked Gunn Occ. 42 000 GHz +18 dBm	
HUGHES 47974H-1000 WR15 SPST PIN	\$375.00
Switch, 250 MHz speed, 60-62 GHz response KRYTAR 2616S Directional Detector,	
1.7-26.5 GHz, K(f/m)/SMC	\$200.00
M/A-COM 3-19-300/10 WR19	\$450.00
Directional Coupler, 10 dB, 40-60 GHz	
Directional Coupler, 10 dB, 40-60 GHz MICA C-121S06 Circulator, 17.5-24.5 GHz, SMA(t/m/m)	\$75.00
MIDWEST MICROWAVE 3537 DC Block, 0.1-12.4 GHz, SMA(m/l) "NEW" MINI-CIRCUITS ZFDC-20-4	\$40.00
DC Block, 0.1-12.4 GHz, SMA(m/l) *NEW*	*05.00
Directional Coupler 19.5 dB 1-1000 MHz SMA(I)	\$25.00
Directional Coupler, 19.5 dB, 1-1000 MHz, SMA(f) NARDA 3000-SERIES Directional Couplers	\$150.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz	\$300.00
NARDA 3090-SERIES Precision	
High Directivity Couplers	
NARDA 368BNM Coaxial High	\$500.00
NARDA 3752 Coaxial Phase Shifter,	\$1,000,00
0.100 dog /CH= 1.5 CH=	
NARDA 3753B Coaxial Phase Shifter,	\$1,000.00
0-55 deg./GHz, 3.5-12.4 GHz NARDA 4000-SERIES SMA	
	\$75.00
Miniature Directional Couplers NARDA 4226-10 Directional Coupler,	e275 00
10 -10 0 5 10 0 011 - 01114111	
NARDA 4227-16 Directional Coupler,	\$325.00
16 dB 1 7-26 5 CH+ 3 5mm//\	
NARDA 4242-20 Directional Coupler,	\$100.00
20 dB, 0.5-2.0 GHz, SMA(f) NARDA 4247-20 Directional Coupler,	e200.00
20 dB 6 0.26 5 GHz 3 5mm(f)	
NARDA 4247B-10 Directional Coupler.	\$200.00
10 dB, 6.0-26.5 GHz, 3.5mm(f)	
10 dB, 6.0-26.5 GHz, 3.5mm(f) NARDA 5070-SERIES	\$300.00
Precision Reflectometer Couplers NARDA 562 DC Block,	
	\$65.00
10 MHz-12.4 GHz, 100 V max., N(m/l) NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/l)	\$165.00
NARDA 768-10,-20 10 dB or 20 dB	\$120.00
Attenuator, 20 Watts, DC-11 GHz, N(m/f)	
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz	
NARDA 794FM Direct Reading	\$375.00
Variable Attenuator, 0-40 dB, 4-8 GHz OMNI-SPECTRA 2085-6010-00	\$50.00
Crystal Detector, 1-18 GHz, negative polarity, SMA(m/f)	
Crystal Detector, 1-18 GHz, negative polarity, SMA(m/f) PAMTECH KYG1014 WR42	\$250.00
Junction Circulator, 18.0-26.5 GHz	
SONOMA SCIENTIFIC	\$75.00
21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz	e1 000 00
TRG B510 WR22 Direct	\$1,000.00
TRG V551 WR15 Frequency Meter, 50-75 GHz	\$600.00
TRG W551 WR10 Frequency Meter, 75-110 GHz	\$750.00
WAVELINE 100080 WR28 Terminated	
Crossguide Coupler, 30 dB	
WEINSCHEL DS109 Double	\$150.00
Stub Tuner, 1-13 GHz, N(m/f) WEINSCHEL DS109LL Double	\$150.00
WEINSCHEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f)	\$100.00
The second secon	
COMMUNICATIONS	

HP 3780A Pattern Generator /	\$1,000.00
HP 59401A HPIB Bus Analyzer	\$400.00
TEK 1410R NTSC Gen., w/SPG2	
TEK 1411R PAL Gen.,w/SPG12 sync:TSG11 color bars:TSG13 linearity	\$750.00
TEK 1411R PAL Test Gen., w/SPG12,TSG11,TSG13,TSG15,TSG16	\$1,000.00
TEK 1411R PAL Test Gen.,	\$1,100.00
SPG12,TSG11,TSP11,TSG13,TSG15,TSG16	\$1,400.00
TEK 147A NTSC Test Signal	
TEK 148 PAL Insertion Test Signal Generator	\$700.00
TEK 520A NTSC Vectorscope	\$750.00
TEK 521A PAL Vectorscope	\$750.00

MISCELLANEOUS	
FLUKE 2180A RTD Digital Thermometer	\$500.00
HP 7090A Measurement Plotting System	\$1,500.00
KEITHLEY 705 / 2x7055 Scanner	\$400.00
P.A.R. 5206-95,98 Two-Phase Lock-in Amp.,	\$1,500.00
TEK TM5003 5000-series 3-slot	\$450.00
TEK TM5006 5000-series 6-slot	\$600.00
TEK TM504 500-series 4-slot Power Module	\$175.00
TEK TM506 500-series 6-slot Power Module	\$250.00
TEK TM515 500-series 5-slot Traveller Power Module	\$275.00

## LOWEST COST LCD'S ON EARTH



#### VIDEO LCD

4 Inch Video NTSC \$150 Sharp P/N 4LU4E Composite NTSC & RGB Input 12:00 OR 6:00 Viewing Angle Integrated Backlight & Inverter Extended Temp: -10 to + 60 C Brightness: 260 nits Power Consumption: 4.3 Watts

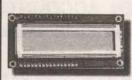


Contrast: 50 to 1

#### **TOUCH MONITOR**

EarthVue 10.4

10.4" VGA TFT Analog VGA Input 105 Nit Brightness RS-232 Touch Screen Option Only 9.9"W x 7.7"H x 1.5"D Ideal For Factory Automation Fully Articulating Ball Mount Only \$1095 With Touch



#### CHARACTER LCD

OPTREX DMF-5005SN-EW 240 x 64 Graphic EL Backlit STN \$30 OPTREX DMF-5005N 240 x 64 Graphic Reflective STN \$30 SANYO DM2023-7G1 2 x 20 Character Reflective STN \$8 SHARP I M20A21 2 x 20 Character Reflective STN \$8 VIKAY 2035TNLD NOTW-D 2 X 16 Character LED Backlit STN \$8



#### LCD MONITOR

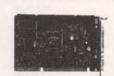
10.4" DSTN or 12.1" TFT Analog SVGA Input Autosync Auto Sizeing Automatic Expansion of VGA images to SVGA (On 12.1") Very Aggressive Pricing Starting under \$500!



#### LCD DISPLAYS

6.3" Mono STN 9.4" Mono Reflective \$60 8.4" TFT \$250 9.4" DSTN \$150 \$350 10.4" DSTN \$240

NoteBook Screens 340 Models in Stock **Obsolete Screens Stocked** Hard To Find LCD? Call!



#### CONTROLLERS

PC/104 NTSC Analog VGA Complete LCD Kits with LCD, Controller & Cable Starting under \$200



Computer Technologies

"The World Leader In LCD Recycling"

Ph: (949) 361-2333 Fax: (949) 361-2121 http://www.flat-panel.com

Write in 62 on Reader Service Card.

## Quality Used Test Equipment 90 DAY WARRANTY Parts & Labor - 10 DAY TRIAL PERIOD

11720A. Pulse Modulator. 2-18 GHz. >80dB on/off ratio \$400 11975A, 2-8GHz Amplifer (use w/11970 series mixers) \$1750 214B, 10 MHz Pulse Generator, 200W Pulse/50 ohms ... \$700 2225A, ThinkJet Printer, HPIB ......\$125 3468B, 5.5 digit Multimeter, HP-IL . 3478A, 5.5 digit Multimeter ..... \$300 \$350 3488A. Switch/Control Unit \$350 3497A, Data Acquisition/Control Unit ... 3498A, Data Acquisition Extender ... 3852A, Data Acq/Control Unit ...... \$300 435A, Power Meter w/sensor cable \$200 436A-02-022, Power Meter w/ sensor cable, HPIB 44462A/63A, 8 Chan MUX/2 Chan Actuator (3421A) ..... \$135 44702A, 13-Bit High-Speed Voltmeter (use w/3852A) ..... \$300 44725A, 16-Chan General Purpose Switch (use w/3852A) \$150 44728A, 8-Chan Relay Actuator \$150 491C, Amplifier, 2 GHz-4GHz, 1 Watt, 30dB Gain 5314A, 100 MHz Counter . \$150 \$200 \$275 5328A-011-020-030, 512 MHz Counter w/DVM, HPIB . 5334A-060, 100 MHz Counter, front & rear input, HPIB . \$300 5334B, 100 MHz Counter, HPIB 5335A, 200 MHz Counter, HPIB \$575 5342A, Microwave Counter, 18GHz, Oven Osc, HPIB ... 5342A, Microwave Colinict, 160H2, Oven Osc, HTB ... 340 6034A, Dig Autoranging Pwr Sup, 60V/10A/200W, HPIB \$650 6034L, Dig Autoranging Pwr Sup, 60V/10A/200W, HPIB \$75 6110A (Harrison), Pwr Sup, 3KV @ 6mA ... \$150 6253A, Dual Pwr. Sup, 0-20V@3A ... \$275 6255A, Dual Pwr Sup, 0-40V@5A 6256B, Pwr Sup, 0-40V@10A 6268B, Pwr Sup, 0-40V@30A 6284A, Pwr Sup, 0-40V@15A 6289A, Pwr Sup, 0-40V@1.5A 6294A, Pwr Sup, 0-60V@1A \$350 \$600 \$100 \$100 6515A, Pwr Sup, 0-1.6KV@5mA (cable kit incl). \$200 69422A, Hi-Speed A/D Card (use w/6940B) .... \$200 69501A, Resistance Programming Card (use w/6940B) ... \$125 69602A, Timing/Pacer Card (use w/6940B) ... \$150 8111A, 20 MHz Pulse/Function Generator, 16Vp-p .... \$1250 8160A, 50MHz Programmable Pulse Generator, HPIB ... \$1600 8444A, Tracking Generator, 0.5-1300 MHz .......\$350 8447A, RF Amp, 0.1-400MHz, 20dB gain, +6dBm out .... \$300 8472A, Crystal Detector, 0.01-18 GHz \$100

8481A, Power Sensor, .01-18 GHz, -30 to +20dBm \$475
8492A, Attenuator, 10dB or 20dB, APC-7\$100
8496H, Programmable Attenuator, DC-18 GHz, 0-110 dB \$375
8501A, Storage Normalizer (use w/8505A) \$750
85041A, Transistor Test Fixture Kit
85131D, 3.5MM Test Port Cable Set (new) use on 8515A \$475
8566A, Spectrum Analyzer, 100Hz-22GHz, HPIB \$12500
8568B, Spectrum Analyzer, 100Hz-1.5GHz, HPIB \$7500
8569B, Spectrun Analyzer, 0.01-22GHz, HPIB \$5500
8640B, Signal Generator, 0.5-512 MHz, AM/FM/Pulse \$700
8660C/86633B/86603A, 2.6GHz Synth Sig Gen
8662A, Synthesized Signal Generator, .01-1280 MHz \$15500
8903B-001, Audio Analyzer, 20 Hz-100 KHz, rear input \$1500
9411B, Switch Controller, HPIB\$450
E1407A, VXI A/B-C-Size Active Adapter\$200
TEVTDONIV

I DIKT ACTIVE	
13-series, 576/577 Curve Tracer Fixtures (12 piece set).	\$250
240-05/(4)D1's, Logic Analyzer w/ (4) P6460 probes	\$650
854, Keyboard Only	\$125
A24, 400MHz Dual Trace Amplifier	\$175
B92A, 500MHz Dual Time Base	\$125
M503, Current Probe Amplifier	\$250
6136, 10X probe, 350 MHz, use w/2400 series o'scopes	\$100
6452, Data Aquision Probe (use w/ DAS9100)	\$150
6460, Data Aquisition Probe (for 1240/1241 Analyzer) .	\$150
G502, 250 MHz Pulse Generator, use w/TM500 series	\$300
S503A, Triple Pwr Sup, 0 to +/-20V@1A, 5V@1A	\$150
DS460-1M, 350 MHz Digital O'Scope, 4-Channel, extra	

emory, includes 2 new P6138A probes & manuals .. \$4500 TDS540A-1F-1M,500 MHz Digital O'Scope, 4-Channel, extra memory, 1.44 floppy, 4 new P6139A probes, manuals \$8200

MISCELLANEOUS	
AstroMed ASC902, Medium Gain Amplifier Plug-in	\$100
Boonton 92BD, RFMilivoltmeter, 10KHz-1.2GHz	
EIP 545A-05-08, Microwave Counter, 10 Hz-18 GHz	\$550
EMI SCR150-5-OV, Pwr Sup, 0-150V@5A	\$350
ESI DB62, 6-Decade Resistance Box, 0-1,111,110 ohms	\$300
Fluke 6010A, Synthesized Func Gen, 10Hz-11MHz, GPI	B\$225
Fluke 8922A, Digital RMS Voltmeter, 2 Hz-11 MHz	\$400
Heise 711B, Digital Pressure Gauge, 0 to 30 PSI, .05%	\$350
Interface 553, Mil-Std-1553 Anaylzer	
Kepco ABC1000M, Pwr Sup, 0-1000V@20mA	\$100
Kepco BHK 1000-0.2M, Pwr Sup, 0-1000V @ 200mA	
Kepco BOP20-10M, Op Amp/Pwr Sup, +/-20V, +/-10A	\$300
Microdyne 1400-MR Telemetry Receiver w/Plug-ins	\$800
Oram Power Supply, 0-270V @ 10A	\$350
PAR 128, Lock-in Amplifier, 0.5Hz-100KHz	. \$500
RF Power Labs M102L, RF Amp, 30Hz-100MHz, 2W	. \$450
Simco SS-2X, Electrostatic Locator Meter w/case & prol	e \$90
Sorensen DCR20-115B, Pwr Sup, 0-20V@115A	. \$475
Sorensen SRL40-25, Pwr Sup, 0-40V @25A	\$475
Wavetek 178, 50MHz Programmable Waveform Synth	
Wavetek 271-02, 12MHz Pulse/Func Gen, GPIB	\$400
Wavetek 859, 50 MHz Prog Pulse Generator, GPIB	. \$575
E DIVIC	



#### TEST EQUIPMENT PLUS (520) 575-6967, FAX (520) 575-6936

3331 W. Bright Terrace, Tucson, AZ 85741





Write in 63 on Reader Service Card.

Continued from page 20

#### FEBRUARY 2000

#### FEBRUARY 5

MI - NEGAUNEE - Hamfest. Hiawatha ARA, Bill Beitel N8NRG, 906-226-2779. E-Mail: n8nrg@portup.com SC - NORTH CHARLESTON - Hamfest.

Charleston ARS, Jenny Myers WA4NGV, 843-747-2324. E-Mail: brycemyers@aol.com Web: http://www.qsl.net/wa4usn/index.html

#### FEBRUARY 5-6

FL - MIAMI - Southeastern Division Convention. Dade Radio Club, Evelyn Gauzens W4WYR, 305-642-4139. E-Mail: w4wyr@bellsouth.net Web: http://www.hamboree.org

#### FEBRUARY 11-12-13

FL - ORLANDO - State Convention. Orlando ARC, Ken Christenson KD4JQR, 407-291-2465. E-Mail: KD4JQR@Juno.Com Web: http://www.oarc.org/hamcat.html

#### FEBRUARY 26

VT - MILTON - NVT Winter Hamfest, High School, Rt. 7. Mitch W1SJ, 802-879-6589. E-Mail: w1sj@arrl.net Web: http://www.ranv.together.com

#### FEBRUARY 27

FL - ZEPHYRHILLS - Hamfest. Zephyrhills ARC, Ernie Vanselow KD4VRV, 813-783-8389 E-Mail: kd4vrv@gte.net

#### **MARCH 2000**

FL - NEW PORT RICHEY - Hamfest. Gulf Coast

ARC, Rickie Brown KF4GXS, 727-863-1457. E-Mail: richar@gte.net. Don KK4VK, 727-848-8000. Web: http://homel.gte.net/koerner/gcarc.htm

#### MARCH 5

NY - LINDENHURST - Hamfest, GSBARC & SCRC, Lenore N2KYP, 516-785-0826. E-Mail: info@gsbarc.org Web: http://www.gsbarc.org

#### MARCH 11-12

NC - CHARLOTTE - Charlotte Hamfest and Computerfair. Mecklenburg Amateur Radio

#### MARCH 18

FL - STUART - Hamfest. Martin County ARA, Romund Madson KS4KM, 561-337-1841

#### MARCH 18-19

TX - MIDLAND - West Texas ARRL Section Convention, Beverley Harwood KC5BNT, 915-686-1841. E-Mail: shamrock@apex2000.net Web: http://www.lxnet/edge/midswap.htm

#### MARCH 19

OH - MAUMEE - Hamfest. Lucas County Recreation Center, 2901 Key St. 8am-2pm. Talk-in: 147.27+ or 442.85+. Toledo Mobile RA, Paul Hanslik, 419-385-5056. Web: www.tmrahamradio.org

#### MARCH 25-26

MD - TIMONIUM - Greater Baltimore Hamboree & Computerfest/MD State ARRL Convention. Timonium Fairgrounds, York Rd. Sat: 8am-5pm, Sun: 8am-4pm. VE Exams. Baltimore ARC, Sharon Dobson N3QQC, 410-HAM-FEST or 800-HAM-FEST, E-Mail: n3wd@amsat.org Web: http://www.gbhc.org

#### APRIL 2000

#### APRIL 8

WA - SPOKANE - Hamfest, Lilac City ARC, Warren Kelsey KJ7BB, 509-534-8443

#### APRIL 9

NC - RALEIGH - State Convention, Raleigh ARC, Chuck Littlewood K4HF, 919-872-6555. E-Mail: k4hf@arrl.net WI - STOUGHTON - Hamfest. Madison Area

Repeater Assn., Paul Toussaint N9VWH, 608-245-8890. E-Mail: n9vwh@arrl.net

#### APRIL 16

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html MI - GROSSE POINTE - Hamfest. South Eastern MI ARA, Jerry Rosner N8FGK, 313-331-3336. E-Mail: n8fgk@amsat.org

#### APRIL 21-22

AR - LITTLE ROCK - Little Rock Hamfest, Jim Blackmon K5VZ, 870-246-7833 (h) or 870-246-6734 (w). Fax: 870-246-6736. E-Mail: Irhamfest@usa.net

#### Web: http://www.aristotle.net/-ares/hamfest/ APRIL 22

NH - NASHUA - Hamfest. Res Ctr Church. NE Antique RC 617-923-2665

#### APRIL 29

AL - MOULTON - Hamfest, Bankhead ARC, Web: http://www.n4idx.org
IA - DES MOINES - Hamfest. Des Moines RAA, Duane Bower WBOUCY, 515-287-6542.

E-Mail: duaneab@uswest.net

#### **MAY 2000**

WI - CEDARBURG - Hamfest, Ozaukee RC, Joe Holly AA9HR, 262-377-2137; E-Mail: aa9hr@execpc.com. Skip Douglas, 262-284-3271

#### MAY 6-7

AL - BIRMINGHAM - Hamfest. Glenn Glass KE4YZK, 205-681-5019. E-Mail: ke4yzk@bellsouth.net Web: http://www.bro.net/barc/slideshow/index.html

#### MAY 7

NY - YONKERS - Flea Market. Lincoln High School, Kneeland Ave. 9am-3pm. VE Exams. Talk-in: 440.425 PL 156.7, 223.760 PL 67.0, 146.910, 443.350 PL 156.7. Metro 70cm Network, Otto Supliski WB2SLQ, 914-969-1053. E-Mail: wb2slq@juno.com Web: http://www.metro70cmnetwork.com

#### MAY 12-13

NH - ROCHESTER - Hamfest. Fairgrounds. Hoss Traders, Joe, 207-469-3492

#### MAY 19-20-21

OH - DAYTON - ARRL National Convention. Dayton ARA, Dave Coons, WT8W, 937-849-0604. E-Mail: wt8w@arrl.org Web: http://www.hamvention.org

#### MAY 21

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html

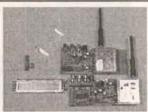
### HAM GEAR FOR SALE

WANTED: ROCKWELL-Collins HF-80 equipment, 851S-1, 237B-3 log periodic, Collins literature. Jim Stitzinger 805-259-2011, 805-259-3830 (fax), bfl-jfs@smart link.net

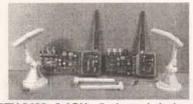
50KW RF generators. made by Westenhouse. Call Mike, phone/fax: 828-684-7672. HTTP://WWW.CHIGE OR.COM

FOR SALE: ORBIT 360 antenna rotator. Full instructions. Never used, \$40 obo. 949-494-0072.

LML RADIO & electronics. Let us be your one stop shop for all your radio equipment, test equipment & other surplus needs. Free catalog. Call 909-873-1319 or fax on demand 24 hr. 909-820-1885 & our new web catalog: Http://members.aol.com/hrh6/LMLinc or LML, 424 E. Shamrock, Rialto, CA 92376.



GET FULL control of frequencies from 2.2GHz to 2.7GHz on your existing RF link or Matco transmitters and receivers. These easy-to-assemble kits are fully PIC controlled, have an easy-to-read LCD and store set frequencies in memory. Kits are \$59.95 ea. or \$99.95 ea. preassembled. Additional price breaks are available when sold with transmitter and receiver combination. Inquire at: atvcam@excite.com



ATV-2400, 2.4GHz 8 channel designed for legal use in ham bands. EZATV, www.4atv.com

DRAKE TR7 & R7 service kit extender boards and digital jumper card. Same as originals, \$63.20. Bob 509-765-4721. rsrolfne@atnet.net

http://www.hackersheaven.com

### HAM GEAR WANTED

ARC-5 RECEIVERS and original manuals. John Broussard, 312 Guilbeau, Breaux Bridge, LA 70517.

WANTED: PROGRAMMER for ICOM IC-H10 handheld radio. 2 versions were available. The stand-alone EX-704 and the PC software version EX-1211 (ver. 4 or higher). Will gladly pay for copying of PC version & instructions. Ph: 217-852-6646.

### CB - SCANNERS

HALCON COMMUNICATIONS
Wholesale only: Cobra, Uniden, Midland,
Galaxy, CTE, Super Star, Kenwood,
Yaesu, Icom. Free catalog, Free call 1-800-683-6999.

SALES & SERVICE: CB equipment, modification kits, meters, antennas, mics, radios, transistors, repairs & hard-to-find items. Complete list \$4. D&R Electronics, 10 Park St., Thomaston, CT 06787. 860-283-9492 or RTed821836@aol.com

CB MODIFICATIONS! Frequencies, books, kits, high-performance accessories, plans, repairs, amplifiers, 10-meter conversions. The best since 1976! Catalog \$3. CBCI, Box 1898NV, Monterey, CA 93942. www.cbcintl.com

**Discount electronics** books. See the NV Bookstore ad on page 6.

240+ CHANNEL CB/HAM/COMMER-CIAL radios: AM/FM/SSB/CW export/domestic: RCI, Motorola, Uniden, Cobra, Alinco, Kenwood. Mics, antennas, linears, meters, books, night scopes, and tons more stuff! Catalog \$3. MAXTECH, Box 8086, New York, NY 10150. 718-547-8244.

SHOOTING STAR, Palomar, Superstar, Galaxy, Uniden, Cobra, exports, police & fire & military scanners, microphones, power supplies, antennas, modifications, repairs, morel! 15 yrs. in same location, 5 page picture price sheets \$1 (refundable). Galaxy, Box 1202, Akron, OH 44309. (Also, Red Devil & Messinger Products.)

# MUSIC & ACCESSORIES

# COMPUTER HARDWARE

450MHz BAREBONE systems from \$250. 486 computers \$99. Brand new Pentiums from \$199. Motherboards \$20, 1.44/1.2 floppies, speakers \$10. Call 714-778-0450.

# Electronics made easy W@ @ kits

MK111 ADJUSTABLE INTERVAL TIMER WITH RELAY \$9.

OUTPUT

For intermittent operation of circuits and equipment. Blinking light, video/photo single frame shooting, slide projector control, miniature models. 5A output relay with dry switch-over contact. Pulse time adjustable between 0,5 and 5s. Pause time adjustable between 2,5 and 60s. Power supply: 12000.1200.04

MK113 SIREN SOUND

GENERATOR

\$12.95

Generates 4 different sounds: police siren, fire brigade, emergency vehicle and machine gun.

Adjustable sound pitch Power supply: 9V battery in switch and PCB speaker inc

of the little of

battery (not included). On/ eaker included.

K4102 GUITAR PRE-AMPLIFIER WITH HEADPHONES OUTPUT



Practice the guitar without disturbing others.

Adjustable input sensitivity. Tone control.

Headphone output with 3.5mm stereo jack. RCA line output to amplifier. Metal enclosure included. Power supply: 9V battery. Dimensions: 2.81 x J.2" x 4.1.

Available at:



Tel: (800) 877-0072

K8009 MULTIFUNCTIONAL CLOCK

This project also displays date and temperature, has \$89.95

a built-in chronograph with lap time, counts down to a preset date, keeps the score of a two-team game, generates random numbers, throws two dice, counts up or down, includes a chime function and is equipped with a time or temperature alarm with relay output. It supports both European and US readout formats for time, date and temperature. All options are selectable from a distance with the included RF key chain remote. Wired control is also possible. Easy to understand menu structure. With backup battery facility. Optional enclosure: B8009

Fixed 433.92MHz transmitter frequency, as required by law. Temperature indication from 0 to ±150°F (resolution 2\*). Memory backup option: 9V battery or rechargeable tattery T331. Relay output: 1A / 24V max. 12VDC/300mA power supply. Dimensions: 10 x3.1 (without enclosure)

K2620 GIANT VU METER



Amaze your friends with a huge VU meter with ordinary 110VAC lightbulbs. 12 trioc outputs, bar-graph style. Up to 2A/channel, Hook-up to speaker or line output.

Power supply - XVAC / 0.5A Dimensions - 6.7×3.3

K2657 SLOW ON/ SLOW OFF DIMMER KIT

\$24.95

Simulate day-night rhythm, or use as staircase light timer. Dual operation mode: Slow on/ slow off mode and Timer/ dimmer mode. Both modes have adjustable cycle time (up to 1 hour). Push-button operation.

Power supply: 24, 110 or 220-240VAC 50/60Hz. Max. load: 2A. Dimensions: 2.8" x 3.8"

NOT JUST A CLOCK!
\$89.95

K4304 MONO 10 LED

\$18.95

**VU METER** 

Add a visual readout to your existing or new apparatus. Range: -20dB to +3dB. 7 green, 2 yellow and one red LED. Dot or bar mode selectable. Attractive front panel for horizontal and vertical mounting included.

Input sepsitivity: 150mV to 60Vrms. Power supply: 10 - 15VDC / 250mA. Dimensions: 1.5" x 2.7".

Also available in stereo version: K4305 \$29.95

K6706A TWO CHANNEL RF KEY CHAIN TRANSMITTER KIT

\$19.95

7

our K6727, and K8009 kits. Very handy key chain size. Over 8000 code settings for your security. Transmitter does not need to see the receiver.

receiver, 433MHz operation, Max open field range 30m / 98. Needs 12V battery type V23GA or GP23A Approved design. Dimensions: 1.4 × 0.6 × 2.3".

K6727 TWO-CHANNEL RF REMOTE RECEIVER KIT



Operate lighting,

arm alarm systems, open carports, etc from a comfortable distance. Goes with the K6706A key chain transmitter. Control appliances up to 5A. Easy to assemble, no coils to wind. Over 8000 code settings for your security. Receiver does not need to 'see' the transmitter.

433MHz operation. Power supply: 2x9VAC or 12 to 16VDC / 100mA max. Dimensions: 3" x 3.3".



7415 Whitehall Street Suite 119 Fort Worth, TX 76118

(817) 284-7785 F: (817) 284-7712

www.velleman.be email: velleman@earthlink.net

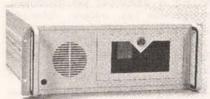
Questions ? Contact us for a list of US distributors or to get your FREE catalogue

NEW JVC external SCSI CD-recorder kit with Adaptec card and Adaptec software \$130, includes 11 pcs. of media in jewel cases plus cables! New 4meg PCI video card (ATI clone) \$25. There are other deals too! For the latest dealsheets E-Mail: dealsheets@utwe.com or call 626-930-1121 (10am-5pm Pacific) or fax 626-930-1123. E-Mail: sales@utwe.com

CRTs CHEAP. Buy direct from the manufacturer. Save money. Mfg. all CRT types since 1950. 3 year warranty. Reg-Res 19" tubes \$75; 25" \$100; hi-res 13" tubes from \$80. We specialize in hi-resolution video/computer CRTs. T.M.C. 215-226-0749/215-223-0388.

PC CABLES: http://www.cablesusa.com 100s of hard-to-find new cables and parts, pictures, free technical information. Low prices, RS232, SCSI, key-board, network, VGA, Cat-5, USB, Firewire, fast secure online ordering & browsing. 954-418-0817.

WE CARRY a variety of cables, switch boxes, accessories, and adapters to connect PCs, printers, Mac's, networks, telecommunications, and audio/video equipment. We offer: custom cables, free catalogs, and same day shipping on most orders. Visit our website at www. rogerssystems.com or call 1-800-366-



19" RACKMOUNT ATX PC chassis, \$169 (with ad). 972-242-8087, www.cti -tx.com

http://www.hackersheaven.com

SONY/AMIGA/MAC/IND. MULTISCANS CPD-1302/1390 TTL/analog sync/gen. Refurb. 6 mo. warr. \$175. Pikul & Assoc. 314-937-0335.

TOKEN RING card. SMC Master 32 (EISA). New, unused, \$40 ppd. OBO Peter Haas, 720 Portage Trl., Cuyahoga OH 44221-3035. Falls. Pete702@Juno.com

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.

**EVERYTHING NEW** w/warranty! Motherboards with CPU 450MHz \$195, monitors 15" \$125. Pentium systems from \$195. Modems, multimedia kits, scanners, 2.5 gigabytes hard drive \$65. Call 714-778-0450. E-Mail: cci@surf side.net



433MHz INTEL CELERON/A 128K cache CPU and Pentium II motherboard super combo deal including AGP 3D 8MB video, 3D 32 voice PCI digital sound, 1 floppy, 2 UDMA/66 IDE, seri-al/parallel, USB, IF and PS2 ports, 56K modem/FAX/voicemail, 10/100 LAN, ATX or normal power connectors, CD-ROM disc w/drivers & many FREE applications software, 2 year warranty and super confident upgrade tech support. Only \$179. Order and find latest prices or more information at 847-657-1160 or www.save ware.com



433MHz PII system with Intel CELERON/A 128K cache MMX CPU, 6.2 gigabyte hard drive, 44X CD-ROM, 1.44 floppy, 32 megabytes SDIMM memory, 8MB AGP 3D video, 56K modem/voice/fax, 32 voice 3D sound, 360 watt speakers, multimedia keyboard, Internet mouse, ATX professional case, 2 year parts and labor warranty, with the best lifetime tech support to keep you and your computer happy! Only \$489! Everything installed with FULL versions WIN95B \$49, WIN98 \$99. Order and find more information plus latest lower prices at 847-657-1160 or www.saveware.com



**PLAYSTATION** GAME SONY ENHANCER, mod-chip function plays backup COPY of CD. You do not need to have original loaded to play backup. Simply plug the enhancer in back of playstation! Skips both Sony logos, many preloaded cheat codes, type in more found on the Internet. Memory management function, view video/movie files from CD, PC computer link port \$29. Quantity prices available. 240 save game memory card \$25. 847-657-1160 or www.saveware.com

4 MB, 72 pin SIMMs \$4 ea. P-100 CPU \$25 ea., 400 VA UPS \$30 ea. Pikul & Assoc. 314-937-0335.

### AMAZING MINI MICRO FM

RADIO! \$7.50

Much lighter than a heavy jam box with really good sound!

This tiny radio
(1.5"x1.06"x0.38") has a seek
button, reset control, and an on/
off switch. Personal listening has never sounded better!

Ideal for ballgames, studyhall, and workouts. Battery and nugget style earphones included.

### GIANT ARROW KIT \$23.95

It flashes, it chases, it lights up in pretty colors! This giant arrow features 81 yellow and green LEDs, an on/off switch, and a potentiometer to adjust the speed of the arrow action. Comes complete with these and all other parts, a clearly marked circuit board, and an assembly instruction sheet with schematic diagram and troubleshooting tips. Operates on 12VDC, so you can run it on your car battery, a wall pack, or any other appropriate power source you select.

### Passive Infra-red Talking Motion Detector III \$27.50

"Stay out of that refrigerator I",
"Watch your step!", "Do your
homework", "Don't touch that
remote!" ... The possibilities are mind-boggling with this talking motion detector. You speak into it to record your message (upto 12 seconds long), turn the unit on, and instantly your voice (or your mother-in-laws) reminds anyone in the vicinity that you were expecting them. Message can be changed with the flip of a switch. Uses 4 AA batteries (not included), or an external

power source (built-in jack). May be used independently (80 db output) or with an amplified speaker to blast your message throughout the house. Approx 4"x 3-1/2"x 1-1/2".

### **PHOTON II** MICROLIGHT

The popular photon microlight has been mproved. These super-bright (better than 8 ndellas!) LED lights are visible over a mile away. The LED is secured in a tough ABS case and offers a squeeze button for quick use, and a constant on slide switch for prolonged lighting needs. The lithium batteries last a very long time (10 year shelf life!) and are included. The light won't burn out because it is an LED!

Specify your choice of five incredible bright colors. Great for home or office use, popular with fire and rescue professionals, pyrotechnicians, stage performers, and dimly lit restaurant patrons. PHOTON II microlights include a keyring and come in ruby red (\$13.50), amber yellow (\$13.50) orange (\$13.50), sapphire blue (\$17.50), diamond white (\$17.50), turquoise (\$17.50), and emerald green (\$17.50). Includes two replaceable 2016 lithium batteries.

### .......... RF LINEAR POWER BOOSTER AMPLIFIER KIT \$39.95

A quick and simple boost for signal generators, transmitters, and other low power devices, this kit can boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz. Operates on 12 to 15 vdc @ 250 mA, via a 2.1mm male power jack. 38 dB gain at 10 MHz, 10dB at 1000 MHz. Optional case \$14.95

### \* Geophone

Geophone
vibration sensing kit

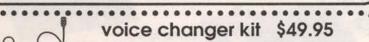
Detect a fly stomping across the desk!

Well maybe not that sensitive, but almost. These vibration sensors made by Geosource® were used in oil exploration to determine geological statistics. They are made with a magnet suspended in a coil and are very sensitive to vibration.

Compact size, the unit measures approx. 1.6\* high and 1.2\* dia.

The kit includes a geophone vibration sensor along with parts to build a basic detector that will light an LED. In addition we include a schematic that will show you how to operate a relay. The sensitivity is adjustable, so you can set it to detect elephants and other small creatures. Similar units were used by our armed forces to detect enemy troop movements...the perfect device to alert you to the pitter patter of little Leroy's feet! Unit sensitivity can be set high enough to detect a business card dropped on a table, and we've made it work with vibrations up to 40 feet away! Earthquake or Aunt Agatha...you decide! It's a fun gadget with many uses.

COMPLETE GEOSENSOR KIT....\$ 9.95 GEOSENSOR UNIT ONLY....\$7.95



Change your voice with this really cool kit! Using DSP (Digital Signal Processing), you can make a man sound like a woman, make a woman sound like a man, create scary monster sounds, and have lots of fun. Use the special echo and vibrato modes for additional special effects. Kit features clip-on electret mic, removable speaker with metal case, sound effects selector switch, adjustable volume control, up/down pitch shifts, and step-by-step instructions. 3.5mm jacks for the microphone and speaker make it easy to connect to other audio equipment. Requires 4 AA batteries (not included.)



### 4 inch color video monitor \$195.00

Mini LCD monitor is great for RV use (add a camera and you can watch the rear of your vehicle as you back-up - nifty reversing switch adjusts the image on the display for exactly this use!) Requires 12 VDC, and includes a power cable with an auto cigarette lighter plug for car use. Mounting stand also included! Measures approx. 5.7" x

4.1"x1.6", with a 4" color display. Inputs for both video and audio - great for camcorder playback viewing, and the kids will love it when you include your VCR in the family vacation plans!

Special note for Ham Operators -we've got the two-pin spade connectors most mobile radios use! \$2.95 ea.

# z.gatewayelex.com



Requires 4 AA batteries (not included.)

THE FINE PRINT: PRICES SUBJECT TO CHANGE WITHOUT NOTICE \* GATEWAY IS NOT RESPONSIBLE FOR PRINTING ERRORS \* MASTERCARD, \* VISA AND DISCOVER ACCEPTED \* VISA, WILL TAKE YOUR CHEEK. \* SORRY, NO. C.O.D.J.\* \* SOME PRINTING ERRORS \* MASTERCARD, \* VISA AND DISCOVER ACCEPTED \* VISA, WILL TAKE YOUR CHEEK. \* SORRY, NO. C.O.D.J.\* \* SOME PRINTING ERRORS \* MASTERCARD, \* VISA AND DISCOVER ACCEPTED \* VISA, WILL TAKE YOUR CHEEK. \* SORRY, NO. C.O.D.J.\* \* SOME PRINTING OF THE PRINT OF



30 FT MAST KIT



AB-1244/GRC MAST KIT, 12 aluminum alloy on steel sections form sturdy, lightweight 30 ft 1.7" dia mast. Kit includes 5 each lower and upper sections, 1 ea lower and upper adapter sections, gin pole swivel base, 4 ea 36 and 42 ft guy ropes, 4 guy stakes, 2 guy rings plus 2.5 pound stedge hammer. Part of OE-254/ GRC antenna set; 30 lb sh. New, \$139.50

ELECTRON TUBES, JAN-BOXED unus ELECTHON 10BES, JAN-BOXED unused: 4CX300A Elmac, \$45 4CX5000J Elmac, \$850 4D32 Raytheon, \$28 6B4GA Sylvania, \$17 83 Sylvania, \$9 7360 ECG, \$15.00

Allow money for shipping on merchandise.

SEND FOR OUR NEW 1999 CATALOG

Write in 40 on Reader Service Card.



VISA MASTERCARD DISCOVER Address Dept. N/V

**COMPUTER PRODUCTS at wholesale** and below marked to go at liquidated prices. You will find brand new items with warranty, but limited supply. For this reason, you must call 847-657-1160 or visit www.saveware.com on the web for latest updates. Dealers please call for quantity discounts and many items not listed on the web page. We also brokerage large quantities of used items with 30 day or DAO warranties, designed for fast sale and high yield profits. When opportunity knocks, you either answer or stay behind closed doors.



LOW-COST 12-BIT A/D KITS. \$59 LPT: Analog! PC printer-port interface acquires 8 analog signals. Also features two 12-bit D/As, current sources for sensor excitation and digital I/O lines. QuickBasic and VB software included. 1channel A/D only \$39 http://www.tgn.net/~adnav/ or E-Mail: adnav@tgn.net

ISO-7816 PROGRAMMER READ & WRITE to ANY ISO-7816 device! \*This ISO-7816 programmer is fully assembled and tested. The following is included: 1. Programmer module. 2. RJ11 data cable. 3. Com port adapter (com1 or 2). 4. UL approved power supply. Easy to understand instruction page. For IBM computers only, user must have a DX386 or better machine and use of the Internet.
ONLY \$149.95 plus S/H. TO order, call
231-882-4079. \*Type of software will
allow programmer to work with any ISO7816 device. Software nor ISO-7816
devices are not provided user must prodevices are not provided, user must procure software and ISO-7816 devices. 90 day hardware warranty included!

LOOKING FOR cheap clone PC parts that actually work? Call UTWE for CD-ROMs, hard drives, disk controllers, video cards, mainboards CPUs, etc. For example, NEW Clone-o-matic mainboard with 4 PCI, 4 ISA, 256K cache, I/O built on board with 200MHz AMD \$70. Remember, today we have it, tomorrow we don't! 56K ISA PnP WinModem by Multitech \$20. Case of 7 nearly new Epson keyboards \$21 (\$3 ea.). There are other deals too! For the latest dealsheets E-Mail: dealsheets@utwe.com or call 626-930-1121 (10am-5pm Pacific) or fax 626-930-1123. E-Mail: sales@utwe.com

http://www.hackersheaven.com

UNDERGROUND CDs: Health, hacking, phreaking, free energy, anti-gravity, time travel, many incredible electronic devices, and MP3 stuff: www.hi-tech stuff.com

### COMPUTER SOFTWARE

CAM & MOTION SW/HW: Z-trace, PCB toolpath. Plotcam motion control, step drivers. www.megabits.net/ddt MSG/ FAX 407-452-7197, 407-459-2729. Heater@megabits.net

LIQUIDATION WIN 95/98, Office suites \$10-69. 1,000 games \$25. Windows tutorials \$5, Mastering Windows 98 book \$10, 714-778-0450.

Don't miss a single issue! Have Nuts & Volts delivered right to your door every month for only \$19 per year. Call 1-800-783-4624 INTERNET SECURITY COMPUTER SECURITY POWER METER

e latest tricks and methods hackers use on Net to pirate software (warez), and hack bsites. Includes examples, countermeasures, password defeats, Packet-Switched Networks, UNIX, Sprintnet, X-25, anonymous FTP, brute force techs, lots of tips. More! \$29. wrds=29.4K

INTERNET TRACKING & TRACING Scammers, spammers, stalkers, infectors, and others hide behind the Internet's anonymity to commit serious offenses. Learn from master hackers best methods to track, trace IDs and origins, and to protect your own privacy. More! \$29. wrds=17.0K

INTERNET FRAUDS DATABOOK Internet cons, scams and related frauds now rake in \$2+Billion annually! Most are done anonymously with impunity. Details how they're done, how to ID them, how to protect yourself. More! \$25. wrds=19.1K

COOKIE TERMINATOR: \$25. wrds=8.4K Any 2 for \$49, 3 for \$64

ATM SECURITY

in Forbes! \$24. wrds=17.4K

CHIPHONE CORDLESS GUIDE

How cellphones operate; mods. Vulnerabilities to hack attack; countermeasures. Cloning details for NAMs, ESNs, etc, control data formats, computing encoded MINs, ESNs, SIDHs, Op Sys, PROMs, forcing ACK, test mode and resets, cable diagrams, scanning, tracking, scanner restorations, freq allocations, roaming, step-by-step to keypad-reprogram 100+ popular cellphones. One FREE database search. Plus much on Cordless phones. More! \$49. wrds=80.0K

PAGEN (BEEPER) MANUAL: How Pagers

PAGER (BEEPER) MANUAL: How Pagers work, different types and uses, freqs, advan-tages over and uses with cellphones, and tips tages over and uses with componers, and and tricks. How phreaks hack Pagers; counter-measures. Plus plans for a Personal Pocket Paging System (xmitter and receiver). More! \$29. wrds=11.7K Both for only \$69

THE DIRTY-2 DOZEN! 24+ Hot Hack/Phreak Expose Disks! See Web CATALOG NOW!

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLUSHOT+ utilities, and the legendary FLUSHOT+ droop, pole meters, etc. \$29. wrds=10.4K utilities, and the legendary FLUSHOT+ protection system. Internet advice, pass-word defeats, glossary - much more! Manual + PC Disk! \$39. wrds=49.5K

THE HACKER FILES: Expose' HD PC disks filled with choice raw, colorful, highly informative hacker, phreaker text files covering many topics! \$39.

Both for only \$69

BEYOND VAN ECK TEMPEST Remote eavesdropping plans of TV video "noise" signals. Range up to 1 KM. Describes how van Eck systems work, and are also used in surveillance of computer systems. Plus TVRO vs phone privacy detailed! \$29. wrds =14.9K. Van Eck Demo Tape is \$29. (15 min).

Both for only \$49!

CALLER ID & ANI SECURITY

fronts, supercool, More! Case histories, labeled internal photos, figures. \$39. wrds=41.0K

PBX SECURITY

PBXs hacking losses of \$5-\$10 Billion/yr! Detailed vulnerabilities (especially for out-dial), countermeasures. Exclusive author interview in Forbes! \$24. wrds=17.4K

Both for only \$49!

CALLER ID & ANI SECURITY

How they work and the many vulnerabilities performed to the property of the proper

on-demand, protocols, parameters, compression, encryption, and fax surveillance-type mods. More! \$29. wrds=29.0K

MANY MORE TITLES! THE "GOLDFINGER (See Catalog for prices & descriptions) THE "SILKWOOD" BEYOND PHONE COLOR BOXES HIGH VOLTAGE DEVICES ANSWER. MACHINE SECURITY CASINO SECRETS CHECK & M.O. SECURITY
CREDIT CARD SECURITY
CONS & SCAMS DATABOOK
SOCIAL ENGINEERING POLYGRAPH SECRETS BY AN ORDER OF THE MAGNITUDE **ULTIMATE SUCCESS MANUAL** STEALTH TECHNOLOGY SIMPLE/CHEAP SECURITY ELEC. SECRET & SURVIVAL RADIO

SPM THE VIDEO: Now its easier to learn about KW-HR Power Meters than ever before! This educational video shows you how they work and their anatomy. Demonstrates SPMEM device and external magnetic methods used to slow and stop meters! Hosted by a top expert in the field. From the project of novice to the pro, an excellent source of info on these exciting devices! Great in combo with our SPM-related manuals! \$29. (20 min)

THE I.G. MANUAL: Details external magnetic ways (applied to meters) out-laws use to slow down and stop power meters while drawing full loads. \$25. wrds=4.9K

KW-HR METERS: How watt-hour energy meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow, stop power meters by others. \$25. wrds=24.2K

wrds=24.2K
Any 2 for \$49, 3 for \$64, all 4 for \$79

VOICE MAIL SECURITY

VMSs are hacked to penetrate PBXs to make outgoing calls, get free VMB usage, secretly read/change/delete messages, control/damage the VMS (or its PBX) itself. Details how they do it, countermeasures. A must for users, sysops, security personnel! \$29. wrds=14.2K

POWERFUL STOCK SOFTWARE SECRETS OF SOLDERLESS BBS MIND CONTROL UNDER ATTACK! RADIONICS MANUAL HEAL THYSELF! SECRET & ALTERNATE IDS **CRYPTANALYSIS TECHNIQUES** GOVERNMENT LAND GRAB ROCKET'S RED GLARE VORTEX GENERATOR SURVIVAL GUNS & AMMO THE ULTIMATE DRIVER Plus Many More - Order Today!

CONSUMERTRONICS CATALOG \$1 WITH ORDER, \$3 W/O ORDER, \$3 W/

Established in 1971 by John Williams, MSEE, former DOD weapons engineer and NIH physicist. Featured on CBS \*60

SPECIAL PROJECTS

Minutes,\* Forbes, New York Times. Add \$5 total \$/H (US, Canada). Postal MO is fastest! VISA, MC OK. No CODs. Send #10 \$ASE for \$P Ap 10% OFF all Orders over \$100: \$2.00 OFF all New Orders over \$20 placed by Mail or Fax. wrds=Estimated Word Count

plication Form, else get at Sold for legal educational purposes only. Some publications are controversial! We take no responsibility for anything we publish. See Catalog for WARRANTY, SPECIAL PROJECTS and all other applicable policies.

## Miniature Transmitters and Receivers

### 2 Button / 3 Channel Transmitter



### RF300T

1....\$22.95 \$19.95 ea 10...\$16.95 ea

### RF300XT

1....\$25.95 \$22.95 ea 10...\$19.95 ea

- 300' (XT), 150' (T) Range
- Frequency: 318 MHz
- 59,049 Settable Security Codes
- 12 Volt Battery and Keychain Included Current Draw: 4.8 ma
- Fully Assembled in Case
- Dimensions: 1.25" x 2.0" x .5"
- Push both buttons for the 3rd Channel
- Slide Button Cover Included

### 4 Button / 15 Channel **Transmitter**



### RF304XT

1....\$27.95 10...\$21.95 ea

- 250' Range
- Frequency: 318 MHz 6,561 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.6 ma
- Fully Assembled in Case
- Dimensions: 1.35" x 2.25" x .5"
- Push combination of buttons to achieve up to 15 channels
  - Industrial Controls
    - Surveillance Control
    - Motor Control

### 2-4 Data / 3-15 Channel Receivers



## RF300RL RF300RM

1....\$27.95 5....\$24.95 ea 10...\$22.95 ea

## RF304RL RF304RM

1....\$29.95 \$26.95 ea 10...\$23.95 ea

- Compatible with 300/4 Transmitters ■ 11-24 volts DC Operating Voltage
- 13 ma. Current Draw
- Latching (L) or Momentary (M) Output
- Kits Available (subtract \$5.00 ea.)
- Dimensions: 1.25" x 3.75" x .5" ■ 2 (300) / 4 (304) Output Data Lines
- Binary to Dec / Hex Converter can achieve up to 15 channels
- Schematics Available
- Receiver Board Layout Available
- Custom Design Consulting Available

Visitect Inc.

■ Lighting Control

■ Alarm Systems ■ Garage / Gate Openers

(510) 651-1425 Fax: (510) 651-8454 P.O. Box 14156, Fremont, CA 94539

Email: Support@Visitect.Com Visa / Mastercard, COD

■ Magic Props

■ Medical Alert

■ Monitoring Systems

FREE IBM DISK CATALOG of quality Shareware and CD-ROMs. MOM 'N' POP'S SOFTWARE <ASP>, PO Box 15003-N, Springhill, FL 34609-0111. 352-688-9108. momnpop@gate.net

GCODE95 FOR Windows 95/98/NT. Reads AutoCad DXF files and converts data to GcodeMcode RS274. Writes DXF files or ASCII, RS 232 serial connection to machine tool. Full function editor and 3D graphing. For milling, turning, flamecutting, etc., easy to customize for almost any machine. Download a free trial copy. http://members.aol.com/and rewc119/index.htm E-Mail: andrewc119@aol.com

FORBIDDEN SUBJECTS3 hacking CD-ROM \$12 postpaid. Free trubbleware diskette catalog. Amazing subject matter. No commercial or shareware here, just lots of technical fun! Peregrine Dynamics, 720 Portage Trl., Cuyahoga Falls, OH 44221-3035.

### COMPUTER EQUIPMENT WANTED

WANTED: FOR historical museum, pre-1980 microcomputers, magazines, and sales literature. Floyd, VA 24091-0341 (540-763-3311/540-382-2935). **DEC EQUIPMENT WANTED!!!** We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. KEYWAYS, INC., 937-847-2300 OR fax 937-847-2350.

WANTED: TERMINALS + PRINTERS: DEC, Wyse, IBM, ADDS, Okidata, Data South, Epson, C.ITOH, etc. Call for quote on any surplus computer equipment. Call Jeremy, 603-673-8077.

HP CALCULATORS wanted: models 10, 70, calculator watch, others for private collection. Cash paid. Bob Morrow, 765-855-2348, rkmorrow@aol.com

### **TEST EQUIPMENT**

FEITEK PROVIDES repair, calibration and traceable certifications of test equipment. Free estimates. We buy, sell and trade all makes of test equipment. Visa and MasterCard accepted. Check out our inventory and specials at WWW.FEIT EK.COM 2752 Walton Road, St. Louis, MO 63114, 314-423-1770.

KENTRONIX TEST EQUIPMENT SPE-CIALS. Check our WEB site at http://www.kentronix.com for monthly specials. We are also looking to buy test equipment, coaxial and waveguide components, manuals, etc. Contact Brian at 732-681-3229 or FAX 732-681-3312. E-Mail: brian@kentronix.com

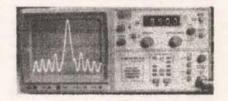
BRUEL & KJAER BUY, SELL, BEST PRICES. EXCALIBUR ENGINEERING, 3198-C AIRPORT LOOP DRIVE, COSTA MESA, CA 92626. 714-540-0169. FAX 714-540-5417.

HP 4815A Z-meter: Expert restoration or verification to HP/QA factory specs. Former HP tech/supv, tel 908-852-7989 or E-Mail: GeoSA4815@compuser ve.com Webpage: http://ourworld.com puserve.com/homepages/GeoSA4815

**EQUIPMENT CLEARANCE.** Electronic test, avionics test, NDT. Most 8 yrs old+. For list, E-Mail: amslsovt@sover.net Andrew Smith, AMSL, Vermont, USA 802-254-9459.

**DEC EQUIPMENT WANTED!!!** We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. KEYWAYS, INC., 937-847-2300 OR fax 937-847-2350.

MAN'S Spectrum Analyzer/Monitor Receiver Kit. 2 to 1,700 MHz. Basic kit only \$98. Now available with switched resolution filters, tracking generator and direct digital frequency readout. Works with ANY scope or IBM compatible computer. Send stamped envelope for details. Science Workshop, Box 310B, Bethpage, NY 11714. http://www.science-workshop.com



ENGINEER TESTED: Spectrum analyzers, frequency counters, frequency standards, meters, scopes, generators, curve tracers, and more. VISA, MASTER-CARD, AMEX. "Performance tested." NIST calibrated. Warranteed. New & used. Contract engineering. Gary N6ZD. HTTP://TECH-SERVICES.COM 831-385-7519.

TEST EQUIPMENT for sale/wanted (NEW/USED): RF, Microwave, video and fiber optic. Cable TV, Broadcast TV, satellite and related industries. Wavetek, Tektronix, Hewlett Packard and other manufacturers. Spectrum analyzers, signal level meters, sweep systems, TDRs, OTDRs, and much more. PTL Test **Equipment, Inc.** Phone 561-747-3647 FAX 561-575-4635. E-Mail: PTLTE@aol .com http://www.PTLTEST.com

## **Cool Wireless Goodies**

### World's Smallest TV Transmitters



We call them the 'Cubes'... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to



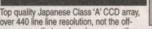
### Doppler Direction Finder

Track down jammers and hidden transmitters with ease! This is the famous WA2EBY DF or featured in April 99 QST. Shows direct bearing to transmitte on compass style LED display, easy to hook up to

on compass style LED display, easy to nook up to any FM receiver. The transmitter - the object of your DF'ing - need not be FM, it can be AM, FM or CW. Easily connects to receiver's speaker jack and antenna, unit runs on 12 VDC. We even include 4 handy home-brew "mag mount" antennas and cable for quick set up and operation! Whips can be cut and optimized for any frequency from 130-1000 MHz. Track down that jammer, win that fox hunt, zero in on that downed Cessna - this is an easy to build, reliable kit that compares most favorably to commercial units costing upwards of \$1000.00! This is a neat kit!!

DRE-1 Panels Piractics Finder Kit
\$140.95 DDF-1, Doppler Direction Finder Kit ......\$149.95

### CCD Video Cameras



over 440 line line resolution, not the offspec arrays that are found on many other cameras. Don't be fooled
by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The
black & white models are also super IR (Infra-Red) sensitive. Add
our invisible to the eye, IR-1 illuminator kit to see in the dark! Color
camera has Auto gain, white balance, Back Light Compensation and
DSP! Available with Wide-angle (80°) or super slim Pin-hole style
lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters
for wireless transmission to TV set, or add our IB-1 Interface board
kit for audio sound pick-up and super easy direct wire hook-up to
any Video monitor, VCR or TV with AV input. Fully assembled, with
pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens \$69.95	
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens \$69.95	
CCDCC-1, Color CCD Camera, wide-angle lens \$129.95	
IR-1, IR Illuminator Kit for B&W cameras \$24.95	
IB-1, Interface Board Kit\$14.95	

### Super Pro FM Stereo Transmitter

Stereo station in easy to use, handsome cabinet. Most radio

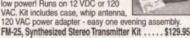


handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will be Great features great drive-ins, schools, colleges find the FM-10U the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. We also ofter a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Pro FM Stereo Transmitter Kit . . . . . \$249.95 FM-100WT, Fully Wired High Power FM-100. . . . \$399.95

### FM Stereo Radio Transmitters

No drift, microprocessor synthesiz Excellent audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strapable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes case, whip antenna,





Lower cost alternative to our high perfo mance transmitters. Great value, easily tunable, fun to build. Manual goes into great detail about antennas, range and FCC rules. Handy kit for sending music

thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or 5 to 15 VDC. Add our matching case and whip antenna set for nice 'pro' look.

FM-10A. Tunable FM Stereo Transmitter Kit. . . . \$34.95 CFM, Matching Case and Antenna Set . . . . . \$14.95 FMAC, 12 Volt DC Wall Plug Adapter......\$9.95

### Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself-in just an evening! These popular little receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squeich except for shortwave and FM broadcast which has handy SCA output. Add our snazzy matching case and knob set for that smart finished look.

AR-1, Airband 108-136 MHz Kit. \$29.95

HFRC-1, WWV 10 MHz (crystal controlled) Kit \$34.95

FR-1, FM Broadcast Band 88-108 MHz Kit. \$24.95

FR-6, 6 Meter FM Ham Band Kit. \$34.95

FR-10, 10 Meter FM Ham Band Kit. \$34.95



Gosh, these babies are tiny - that's a duarter in the picture! Choose the unit that's best for you, FM-5 is the smallest tunable FM transmitter in the world, picks up a whisper 10' away and transmits up to 300'. Runs on tiny

### FM Station Antennas



For maximum performance, a good antenna is needed. Choose our very popular dipole kit or the Comet, a factory made 5/8 wave colinear model with 3.4 dB gain. Both work great with any FM receiver or transmitter.

TM-100, FM Antenna Kit ......\$39.95
FMA-200, Vertical Antenna ....\$114.95

### SR-1, Shortwave 4-11 MHz Band Kit \$29.95 Matching Case Set (specify for which kit) \$14.95 Touch-Tone Reader

FR-10, 10 Meter FM Ham Band Kit. \$34.95 FR-146, 2 Meter FM Ham Band Kit. \$34.95 FR-220, 220 MHz FM Ham Band Kit. \$34.95



Read touch-tone numbers from any radio. phone line, tape recorder - any audio sourcel Decipher called numbers on scanners, radio shows, anywhere touch-tones are used. Mem

good for 100 years, even with power off Runs on 7 to 15 volt DC,
Available in kit form with optional matching case set or fully assembled in case set. We sell tons of these to private investigators!

TG-1, Tone-Grabber Touch Tone Reader Kit......\$99.95

CTG, Case for Tone-Grabber Touch Tone Reader .....\$14.95 TG-1WT, Tone-Grabber, fully assembled with case . . . . . . \$149.95

### AC12-5, 12 Volt DC Wall Plug Adapter ......\$9.95 Order Toll-free: 800-446-2295

Sorry, no tech info, or order status at 800 number For Technical Info, Order Status Call Factory direct: 716-924-4560

## Tiny Transmitters



included watch battery, uses SMT

included watch battery, uses SMT parts. FM-4 is larger, more powerful, runs on 5-12 volts, goes up to a mile. FM4,5 operate in standard FM band 88-108 MHz, easily picked up on scanner or 2 meter rig, runs on 2 included watch batteries. SMT (surface mount) kits include extra parts in case you sneeze & loose a part! FM-4MC, High Power FM Transmitter Kit. \$17.95 FM-5, World's Smallest FM Transmitter Kit. \$19.95 FM-6, Crystal Controlled 2M FM Transmitter Kit. \$39.95 FM-6, Fully Wired & Tested 2M FM Transmitter . \$69.95

AM Radio

**Transmitter** 

Operates in standard AM broadcast band. Pro version, AM-25, is synthe-

### **RF Power Booster**

CLPA, Matching Case Set for LPA-1 Kit ......\$14.95 LPA-1WT, Fully Wired LPA-1 with Case .....\$99.95



## **Dinky Radios**

Everyone who sees one of these babies says they just gotta have one! Super cute, tiny (that's a Quarter in the picture!) FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. The crystal clear sound will amaze you! Makes a great gift. MFMT-1, World's Smallest FM Radio...\$11.95

### CAM, Matching Case Set for AM-1.....\$14.95 RAMSEY ELECTRONICS, INC.

Entry level AM Radio Transmitter Kit. . . . . . \$29.95

793 Canning Parkway Victor, NY 14564

See our complete catalog and order on-line with our secure server at: www.ramseyelectronics.com









not pleased, return in original form for refund. Add \$6.95 for ship ping, handling and insurance, Orders under \$20, add \$3,00, NY resi dents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mall or use credit card and specify shipping method.

AILTECH EATON NM37/57A EMI receiver 30MHz-1000MHz, \$1,000; HP \$1,000; HP 8640B opt 02, \$1,500; HP 8165A programmable signal source 1milhz-50MHz, HPIB, \$900; HP 8620C, 86290B, 2-18.6GHz, sweeper and frame, \$2,200; PTS 040 .1-40MHz synthesizer, \$500; PTS 200 1-200MHz freq synthesizer, \$600; HP 4935A TIMS, \$900; Sencor SC61 wave ana. 0-60MHz scope freq and PK-PK digital read out useable to 100MHz, \$450. A-Comm Electronics 303-341-2283, fax 303-341-

QUALITY EQUIPMENT SALE: HP 4275A multifrequency LCR meter, late vintage, \$3,200; HP 8901A modulation analyzer, \$2,200; HP 3488A switch control unit, \$500 (HP 4447x cards available). HP 4140B pA meter/DC voltage source, with HP 16055A accessory kit, \$2,300; HP 436A/022 RF power meter, with cable, \$900; HP 5343A/1,6,11 26.5GHz microwave frequency counter, \$3,100; **HP 6033A** "autoranging" power supply (20V, 30A), \$900; **HP 8112A** 50MHz programmable pulse generator, \$3,500; **HP 8656B/002** .1-990MHz synthesized signal generator, \$2,100; HP 83522A .01-2.4GHz sweep oscillator plug-in, \$2,350; HP 83570A 18-26.5GHz plug-in, \$2,950; **HP 8410C, 8410B** network analyzer mainframes, \$575, \$395; HP 8411A/018 harmonic frequency converter, \$335; HP 8743B/018 test set \$395; Audio Precision SWR-122F switcher, \$500. All with warranty, most with manual, excellent condition. Pepper (http://home.earthlink.net/~ peppersys) 214-353-0257 fax 214-902-9511. E-Mail: peppersys@earthlink.net

TEKTRONIX DC5010 350MHz counter, \$400; HP 606B sig. gen., \$250; GR1606A RF bridge, \$250; Wavetek 5081. 1 step attenuator DC-1GHz, 0-81db, 10, 1, .1db steps, 50 ohm, \$100; HP K422A detector, \$150; Tektronix LC130, LC meter, \$150; Krohn-Hite 3323 solid state variable, hi pass low pass, band reject dual filter 10Hz-100KHz, \$450; Wavetek 182A 4MHz function gen., \$150; HP 5004A signature ana., \$150. A-Comm Electronics 303-341-303-341-2293, sales@a-2283. fax

**EQUIPMENT SALE:** Hewlett Packard 3336C synthesizer & level generator with options 004, 005, \$1,000; Wavetek 3001 signal generator, \$300; Hewlett Packard 8015A opt 03, \$350; 8015A \$250; HP 3403C opt 03 TRMS voltmeter, \$300, 3403C \$200; HP 3763A error detector, \$300. Offers accepted. Psitech Plus 707-745-4804. Check our new www.psitechplus.com

DESOLDER. STATIONS: PACE: MBT100 \$225, MBT200 \$325, PPS100 \$200, PPS85 base for MBT250 \$350, MBT220 \$700. Weller DS100 \$200, DS1000 \$250. Hot tweezer \$50, ultrasonic cleaner \$75, hot plate \$75, digital solder pot \$150. Hakko 850, Pace MP-1, hot air SMD \$700, solder stations: digital readout Weller EC2000 \$100, EC2002M \$225 new, WTCPN \$50, EC1301 \$50 nu, TC201 \$50 nu, EC1201AFE fumex pencil \$75, WCP1 electric rotary sponge \$25 310-515-

EFRATOM FRK-L rubidium oscillators! 10MHz sine wave output, 0.5Vrms. Long term stability: <1 x 10 10/month. Includes optional mdl. EEK-10 heatsink and I/O connector. Used, with fresh NIST traceable calibration certificate, only \$500 ea. 6 month guarantee! Full specifications and picture at our website. Lehman Scientific 1-800-784-8680, Visa/MC. www.lehmanscientific.com

HP 8640B generator/counter .5-512MC no options AM/FM modulation recently repaired, \$900. 405-247-3480 or gene@tanet.net



voltage and current operation.

01PSGP4303D Digital Display

01PSGP4303A Analog Display \$165.00

School Purchase Orders, VISA/ MC, Money Or er, Prepaid. NO PERSONAL CHECKS, NO COD. NJ Residents: Add 6% Sales Tax 365 Blair Road • Avenel, NJ 07001-2293

Yellow LED T 13/4 10 Min.

100K Pot., 1" Shaft PC Mt. 10 Min., 15¢ ea.

Photo Cell 10 Min.

8¢ ea.

65¢ ea

http://www.elexp.com email: electron@elexp.com

236-Page Catalog

NEW

MODEL TCM-100

RESISTOR KIT

1/4W 5% film, 5

pieces each of

73 values, 365

\*395

100

\$525

pieces total

800-972-2225 Write in 43 on Reader Service Card.

189.00

HP 4800A Vector Z meter, \$850; HP 5340A, 18GHz ctr opt 010, \$1,200; HP 3581C level meter, \$800; HP 8363B sig. gen. 2.3-6.5GHz, \$1,500; HP 618C sig. gen., \$400. A-Comm Electronics 303-341-2283

\$11000

In NJ: 732-381-8020

FAX: 732-381-1572

Assembled

\$15000

ANALYTICAL BALANCES, microscopes, electronic test equipment. Lehman Scientific is a fully authorized dealer for Scientech analytical balances, NOVA microscopes, ES & D pH meters, BelMERIT electronic test equipment, Eagle microscopes, and others. New, used, and surplus! Come check us out! Lehman Scientific 1-800-784-8680, Visa/MC. www.lehmanscientific.com

ALFA ELECTRONICS

DISTORTION, ANAs: HP 339A, \$1,000; HP 334A, \$400; HP 331A, \$250; modulation anas., HP 8901A, \$900; HP 8901B \$1,200. inputs, A-Comm Electronics, 11891 E. 33rd Ave., Unit C, Aurora, CO 80010, 303-341-2283, fax 303-341-2293.

OSCILLOSCOPES: OFFERS accepted, Hewlett Packard 1725A, \$200; 1740A \$150; 1741A \$200; Tek 2215 incal, \$300; Tek 7904 w/7A26, 7A24, 7B80, 7B85 with manual, \$600, 7104 \$800; 1101 probe supply, \$65, 4 available, 1142A probe control power module, \$250, 4 available: Psitech Plus 707-745-4804. Check our new www.psitech-plus.com

HP 4944A, TIMS, \$400; HP 5423A structural dynamics ana., \$1,000; Tektronix 620 XY display, \$300; HP 461A, \$150; HP 465A, \$150; HP 7475A, RS232 plot-ter, \$150. A-Comm Electronics 303-341-2283, fax 303-341-2293, sales@acomm.com

**HEWLETT PACKARD:** Programmable signal generator 8656A opt 001, 002 w/ HP installed attenuator 11810A, \$850; 1024MHz signal generator 8640B opt 002, 003, \$1,200; audio analyzer 8901A, \$550, 8901B modulation analyzer, \$1,250; spectrum analyzer 141T, spec. analyzer frame, \$300. Offers accepted. Psitech Plus 707-745-4804. Check our new www.psitech-plus.com





POWER METERS: Wavetek 1034A, 10MHz-20GHz, +10, -50dbm AC with rechargeable new battery, \$450; HP 436A, 8484A, opt 022, \$1,000; HP 432A, 8478B, \$400; Pacific measurements 1009, \$150; Pacific measurements 1036, -40, +10dbm, \$150. A-Comm Electronics 303-341-2283 fax 303-341-2293. sales@a-comm.com

WE BUY & sell test & measurement equipment. http://www.a-comm.com

PICMASTER EMULATOR system, new, complete, all parts, documentation, boxes, w/16C63 probe, MPLAB software, registered w/Microchip, \$900 obo. 818-349-7920.

NEW, FASTER POCKET TESTBENCH, tiny, inexpensive, portable RS-232 instrument. Scope, logic, counter, generator modes. Oricom Technologies, 303-449-6428, www.sni.net/~oricom

http://www.hackersheaven.com

NEW, USED and surplus stereo microscopes, metallurgical microscopes, toolmakers microscopes, and biologi-cal microscopes! Also analytical balances, oscilloscopes, power supplies and much more! Lehman Scientific 1-800-784-8680, Visa/MC. www.lehma nscientific.com

www.nutsvolts.com

### SECURITY

STOP THEM from listening in or recording your telephone conversations with the TELEPRIVACY-PLUS. Send \$49 to Vakis, 1402 Pine Ave., Niagara Falls, NY 14301.

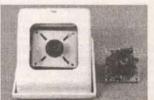
120+ exciting manuals: Electronics, computers, Internet, phones, energy, radionics, financial (including stocks), crime-fighting, security, survival, phenomena, SPECIAL PROJECTS. Catalog \$3. PO Box 23097, Albuquerque, NM 87192. www.tsc-global.com

ALL NEW: THE COVERT CATALOG 2000. The MASTER LIST of information suppliers, specialized newsletters, OEM lock picks, reverse engineers, spy shops, alternate IDs, program crackers, and more. Locate impossible equipment, shop where the smart guys shop. Provides hundreds of addresses, sample pages, catalog prices and recommendations that will save you money on everything from break-in books to unde-tectable bugs. Catalog #COVCAT-2, price \$34.95 + S&H \$6 US, \$7 CAN. NY state add \$3.38 tax. Visa, MC, Discover, money orders. Mail: CRB, PO Box 56-NV, Commack, NY 11725. Phone: 516-

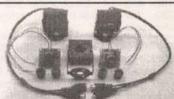


COUNTER-SURVEILLANCE=\$250 HR! Electronic eavesdropping is unbelievably widespread! Are you sure you're safe? Learn how others (without prior experience) earn \$250 HR in the fascinating field of COUNTER-SURVEILLANCE! For catalog call: 1-800-732-**5000.CONSUMERTRONICS** 

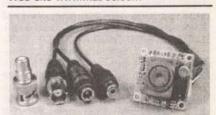
SURVEILLANCE-COUNTERSURVEIL-LANCE: I buy and sell used equipment. Steve 410-879-4035.



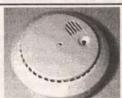
WEATHERPROOF ENCLOSURE for board cameras, fits all 30-42mm color/back & white cameras, \$59. Matco, Schaumburg, IL 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@matco.com Web site www.mat-co.com



COLOR - LOW light CCD pin hole and standard lens available, only 1.27" x 1.27", \$109. Sony sensor with audio. Matco, Inc., 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com



B/W BOARD camera w/audio, \$49 @ qty 10, 1.27" x 1.27". Enclosure available for \$10. Matco, Inc., 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@ mat-co.com Web site www.mat-co.com



**SALE! PS** 102: Built-in pin hole CCD, lens size: 3.6mm. 5-1/2" (D) x 1.7" (H). \$79 @ 5 pcs., \$72 @ 10 pcs. Distributors welcome. Matco, Inc., 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@matco.com Web site www.mat-co.com

# **Tired of Expensive Inkjet Cartridges?** Save 90% on Inkjet Inks!

Printer	# of I	Refills	Cost	Refill	Kit F	rice
	Black	I Color	Black	I Color	Black	I Color
HP 500 Series, 400, Officejet 300, 350, Fax	7	14	4.71	2.85	32.95	39.95
HP 600 Series, Officejet 500, 570, 600	7	14	4.71	3.21	32.95	44.95
HP 820C, 855C, 870C, 1000C, 1150C, Copier 120, 210	6	10	6.67	4.00	39.95	39.95
HP 720C, 722C, 712C, 880C, 890C, 895C 1120C, 1170C	6	10	6.67	4.50	39.95	44.95
Canon BJ-10, 200, 210, 240, 250 Apple SWriter 1200, 1500	14	20	2.15	2.00	29.95	39.95
Canon BJC-4000 Series, C2500, C3000, C3500, C5000	60	60	0.50	0.67	29.95	39.95
Apple StyleWriter 2400, 2500		No.		18_1019		
Canon BJC-600, 610, 620 Apple SWriter Pro	20	13	1.50	3.07	29.95	39.95
Epson Stylus Color, Color Pro, Pro XL	12	12	2.50	3.33	29.95	39.95
Epson Stylus Color II, Ils, 1500 (Black	15	15	2.00	2.66	29.95	39.95
Epson Stylus Color 500, 200	20	17	1.50	2.35	29.95	39.95
Epson Stylus Color 400, 600, 800, 850, Photo	20	17	1.50	2.65	29.95	44.95
Lexmark JP 1000, 1020, 1100, ExecJet II, IIc, Medley 4C	10	17	3.00	2.35	29.95	39.95
Lexmark JetPrinter 5700, 5000, 7000, 7200, 3200	15	17	2.67	2.35	39.95	39.95
Compaq IJ700, IJ900, Xerox XJ9C	15	17	2.67	2.35	39.95	39.95
Xerox Home Center 450C, XJ6C Inkjet	22	12	1.36	3.33	29.95	39.95

## SAVE 30 - 50% on New Compatible Cartridges!

Printer	BLACK	COLOR
	CARTRIDGE	CARTRIDGE
Canon BJC-4000 Series, C2500, C3000, C3500, C5000	\$5.50	\$12.95
Apple StyleWriter 2400, 2500	\$5.50	\$12.95
Canon BJC-600, 610, 620 Apple StyleWriter Pro	\$4.95 (9cc)	\$4.95 @ (9cc)
Hi-Capacity Canon BJC-600, 610, 620	\$5.95 (15cc)	\$5.95 @ (12cc)
Canon BJC-70, BJC-80	\$9.95 (3-pak)	\$14.95 (3-pak)
Epson Stylus Color, Color Pro, Pro XL	\$12.00	\$19.00
Epson Stylus Color II, IIs	\$14.00	\$19.00
Epson Stylus Color 500, 200	\$14.00	\$19.00
Epson Stylus Color 400, 600, 800, 850,1520, Photo	\$14.00	\$19.00
Epson Stylus Color 440, 640, 740	\$14.00	\$19.00

- · BULK Inks, Refill Accessories
- · Glossy card stock & Coated Paper
- · School & Government PO's Welcome

· 2 - 3 Day Shipping

Quality Inks for: HP · Epson · Lexmark Canon · Apple · DEC





## Call or see us online!

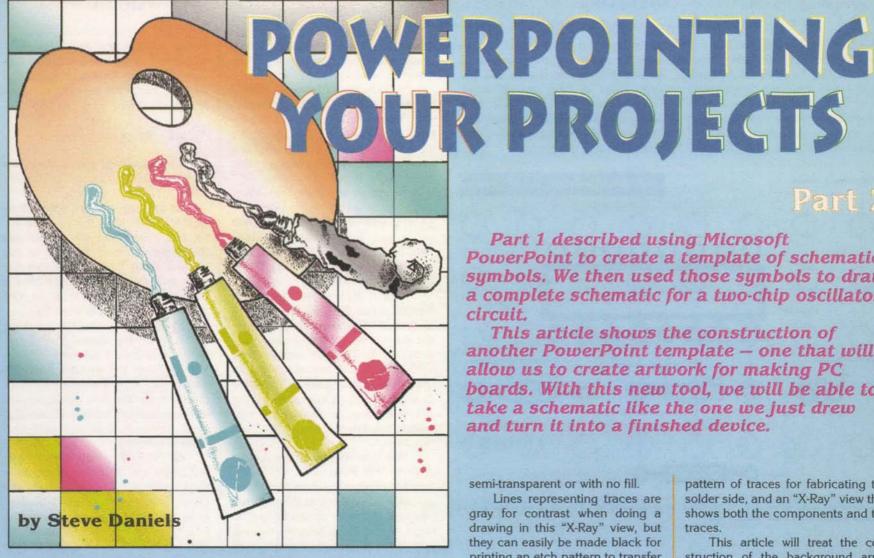
Monday - Friday 8:30 - 5:30 PST 11:30 - 8:30 EST

www.inkjetsw.com

1-800-447-3469

(480) 668-1069 Fax

(480) 668-0959



PowerPoint to create a template of schematic symbols. We then used those symbols to draw a complete schematic for a two-chip oscillator circuit.

Part 1 described using Microsoft

This article shows the construction of another PowerPoint template - one that will allow us to create artwork for making PC boards. With this new tool, we will be able to take a schematic like the one we just drew and turn it into a finished device.

### **Design Considerations**

To position components accurately on an on-screen "virtual board," we need to create an array of pins or holes a known distance apart. This is used as a background against which to lay down actual-size outlines of components.

When I first tried using PowerPoint to do a PC board, I wanted to draw the array on .10" centers exactly the same spacing as on

the perfboard that I typically use for prototypes. This didn't work well, probably because it pushed the limits of the program and my PC's memory, so I compromised and put the holes on .20" centers.

When drawing, I keep in mind that there is a hole in-between each two holes in my array, and I put components in the spaces, as well as on the holes.

Figure 2 shows a small piece of an array of this scale with a few component outlines and traces positioned both on and inbetween the holes.

The finished template (Figure 1) includes a variety of standard component outlines positioned

Figure 1 - Finished Template

conveniently around the outside of a 6" x 4" composition area.

Laying out a PC board is done in somewhat the same way that we drew a schematic; component outlines are copied to the composition area as required, and connected with straight or angled lines that represent the copper traces on a board.

So that we can see both the components and the connection pattern as it takes shape, the component outlines are deliberately created either semi-transparent or with no fill.

Lines representing traces are gray for contrast when doing a drawing in this "X-Ray" view, but they can easily be made black for printing an etch pattern to transfer to a physical board.

Since the background array of holes is created as a single PowerPoint object, it can be deleted easily when it is no longer needed.

I have used the template shown in Figure 1 for several years now to design boards up to 4" x 6" for many projects; now that I have a 19" monitor, I can go to 5" x 7".

I can generate from one template the three drawings that I need to make and document a board: a component side layout drawing, a pattern of traces for fabricating the solder side, and an "X-Ray" view that shows both the components and the

This article will treat the construction of the background array and accompanying component outlines. Next month, we will use the tool to generate an etch pattern for the schematic that we created in Part 1.

### **Before You Start To Draw**

The same caveats that I mentioned in Part 1 also apply here: PowerPoint isn't a CAD program; if you need precision to .001", or if you must create Gerber photoplots to send to a PC-board fab house, you'll have to go through the pain of learn-

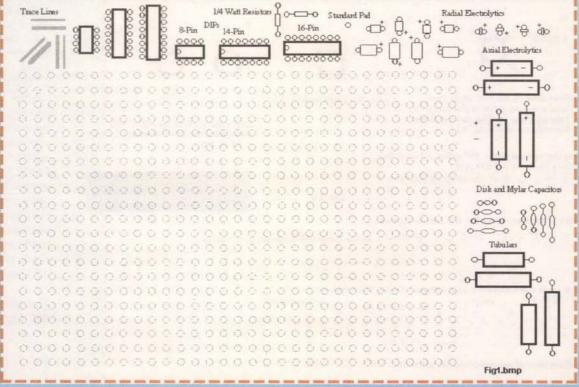
> ing to use one of the many commercial boardlayout packages out there.

My PowerPoint method will work well for the hobbyist who needs a cheap, technically simple way to create a board or two for his/her own

In this article, all menu choices and instructions refer to PowerPoint v7.0; earlier (or later) versions will also work, but some functions needed for this job will be found in different places.

Also, the number of component outlines that you can fit in the library area will depend on the size of your monitor; 17" or better is preferred.

Last, you must be



### POWERPOINTING - POWERPOINTING - POWERPOINTING - POWERPOINTING

fluent with the drawing functions of PowerPoint to tackle this template.

Before we forge ahead: In creating this template, we make heavy use of the Guides feature to do precise drawing. Since I don't expect that even experienced users of PowerPoint will have a lot of experi-

ence positioning objects to .01", I want to share some things I have noticed about how the Guides feature works at high magnification. Unfortunately, Microsoft's help desk (normally very helpful) couldn't confirm whether my experience represents the way the program is "sup-

posed" to work; they have little documentation on the Guides. See Figure 3.

At 400% magnification, I found that each dot on a guide represents .01". Therefore, to get an object centered to .01" at some location, the guides must be adjusted so that the two dots that represent that location are right on top of each other.

As shown in Figure 3(a), when a dot on the vertical guide intersects exactly with one on the horizontal guide, they both disappear. This is fine; it gives a good "bullseye" indication of when we are "really" at a particular position.

Figure 3(b) shows what can happen if you don't use the bullseye indication. The program says that the guide is at .25" left of zero, but it really isn't. The dot representing .25" vertical is in between two dots on the horizontal guide. If you tried to align a series of objects using the guides this way, you'd get very frustrated. You have to make the dots disappear.

This is usually easy, but I have noticed that PowerPoint will occasionally, randomly, refuse to give the bullseye indication that the dots are intersecting. I have always been able to get it to do so by dragging a guide from the side opposite the one I was on and moving it back and forth a couple of times.

Sometimes I've had to go backand-forth between above and below the horizontal, and unselecting whatever I was trying to align seemed to help on some occasions. Figure 3(c) shows this problem and my workaround.

### Ready To Work?

Open a new PowerPoint presentation and set up a new, blank slide as you did previously. All toolbars except for Drawing should be inactive. Zoom should be set to 400 percent, Snap To Grid should be on, and the ruler and guides should be active.

Refer to Figure 4.

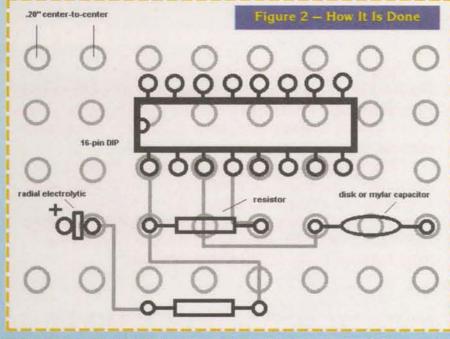
- a) Position the guides at exactly 0 H, 0 V (0.00 horizontal, 0.00 vertical).
- b) Starting from the intersection of the guides, draw the smallest circle that PowerPoint will permit and then turn off Snap To Grid. In the Format menu, Colors and Lines dialog, click the No Fill Color choice and ensure that Style is at the thinnest line setting (Figure 5).
- c) Place the circle so that its center is on the intersection of the guides and leave it selected.
- d) Move the vertical guide to exactly .20" right. Execute a CTRL-D to duplicate the first circle, nudge the copy to 0.00" horizontal and .20" right, center it there precisely and leave it selected.
- e) Move the vertical guide to .40" right and duplicate again. This third copy may not automatically come out centered, so use the arrow keys to nudge it perfectly parallel with the first two and centered on .40" vertical.

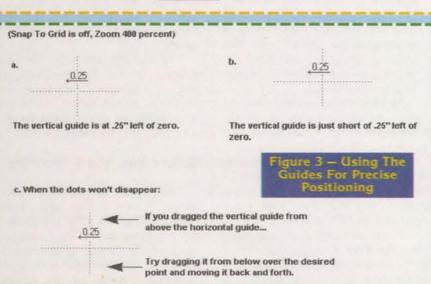
Now continue the process — move the vertical guide .20" to the right, execute a CTRL-D and nudge the new circle into position, if necessary. The last circle in this series should be centered on 3.0" right and 0.00 horizontal.

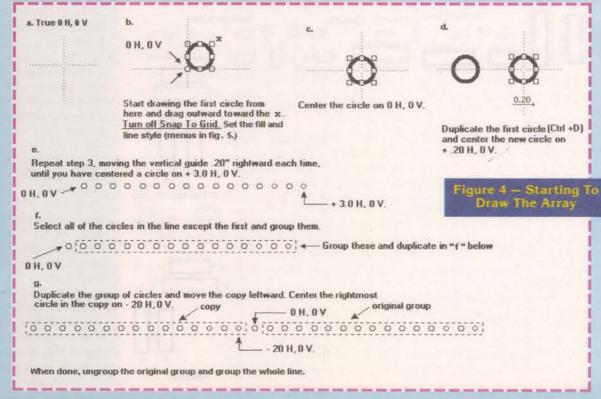
- f) Select all of the circles in the series except the very first one that you drew, group them, leave the group selected, and bring the vertical guide back to 0 horizontal.
- g) Execute a duplicate (CTRL-D) so that you get a second series of circles. Move the vertical guide to .20" left. Drag the newly created group to the left, and nudge it so that its rightmost circle is centered at zero vertical and .20" left. Ungroup this group and click once on any blank area to unselect everything. Check the positions of the individual circles against the vertical guide, moving the guide left in precise .20" increments. Nudge into alignment any circles that didn't come out where they should be. Do the same to the right of zero so that you have a parallel 6" line of circles at even .20" intervals. Ungroup the group to the right of 0 H, 0 V and then group the whole line. Move the horizontal guide up to + .20". Move the vertical guide back to 0 and set the Zoom to 100 percent.

### Create The Upper Half Of The Array

Refer to Figure 6.







### POWERPOINTING · POWERPOINTING · POWERPOINTING · POWERPOINTING

- a) Duplicate the first line of circles and nudge it into rough position at + .20" vertical. Increase the zoom to 400%.
- b) Ungroup the new line. In my experience (which includes doing this template on a couple of different PCs with different versions of PowerPoint), if you created the previous line accurately, you should be able to nudge this one into place as shown and all the circles should be correctly lined up horizontally. Unselect everything and use the vertical guide to verify vertical alignments. Check both left and right of zero all the way to the end. If any circles are out of alignment, unselect everything and use the vertical guide and the arrow keys to nudge them into place. When everything is okay, move the vertical guide back to
- c) At 100% zoom, re-group the line. Move the horizontal guide up to + .40", duplicate the last group of circles and repeat steps a and b: center the copy at 0" horizontal and + .40" vertical, go to 400% zoom, ungroup, and check alignments. Continue this process until you create a 10th line above zero at 2.0" vertical. Reduce the zoom to 100%.

### Complete The Array

Refer to Figure 7.

- a) You have 11 rows of circles. Ungroup all of the circles in the top 10 rows, create one group, and duplicate this group. Lower the horizontal guide to -.20" vertical. Drag and nudge the new group down and into position on the guide. Restore the zoom to 400%.
- b) Ungroup the new group and unselect everything. Just as when you duplicated lines, if you created the previous group accurately and nudged the copy into its correct position, all the circles should be correctly lined up horizontally. Unselect everything and use the vertical guide to verify vertical alignments. Check both left and right of zero all the way to the end. If any circles are out of alignment, use the vertical guide and the arrow keys to nudge them into place. Then correct vertical alignments as you did in 6 (b).
- c) When you are satisfied, make one group of all the circles and color it light gray. Our array is finished (Figure 8).

As you saw in Figure 2, each component lead is terminated with a circle, smaller than the holes of the array, that is used to orient the component. Creating this "standard pad" is the next step, as shown in Figure 9.

a) Create a new slide in this presentation. With zoom at 400 percent, the guides centered at 0 horizontal and 0 vertical, and Snap To Grid on, draw from the intersection of the guides the smallest circle the program will permit, as in Figure 4. Also, set No Fill and the thinnest possible line style as you did before. Turn off Snap To Grid.

b) From the Draw menu, select Scale and reduce the size of this circle to 84 percent of original. Copy

this circle to the slide with the array. (You may have to reduce zoom to 100% to find it.) Now that the "template" slide contains a complete array, take care that the array is not selected when you actually want to move some other object on the slide. If you accidentally move the array, use the undo command (CTRL-Z) to restore it to its position.

c) You can now move the pad up to the area where sample component outlines will be placed, and label it.

Now we can create some component outlines, starting with the most common of all: a quarter watt resistor.

See Figure 10.

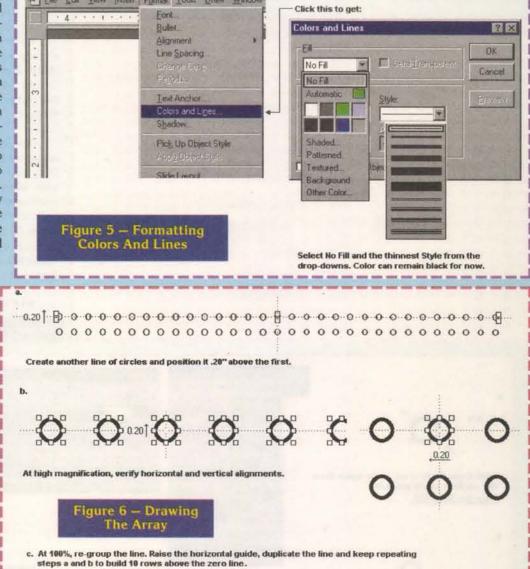
- a) Go to the slide where you created the pad. Make sure Zoom is at 400%, the guides are visible, and Snap To Grid is off. Drag and nudge a standard pad to center on the guides at 0 H, 0 V. The right outside edge of the pad should be at .03" right of zero.
- b) Move the vertical guide to .11'

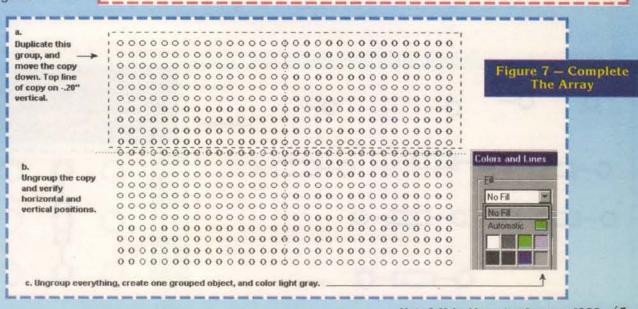
- right. From .11" right, draw a straight line back to the right side of the pad. The right edge of the pad should pass through the center of the handle of the line.
- c) Set the vertical guide to .29" right and the horizontal to .03" above zero.
- d) From the intersection of the guides and dragging left and slightly

Edit Yew Insert Format Iools Draw Windo

downward, draw a rectangle. Stop where the edge of the connecting line begins.

- e) The result should look like
- f) Use the horizontal guide to ensure that the lower edge of the rectangle is at - .03", and adjust the rectangle's size, if necessary. Give the rectangle No Fill and make sure that





### POWERPOINTING - POWERPOINTING - POWERPOINTING - POWERPOINTING

its Line Style is the thinnest possible.

g) Set the vertical guide to .36" right and the horizontal guide to precisely 0.00. Draw a line from the intersection of the guides toward the resistor body. Stop drawing right where the outside edge of the body starts. The connecting lines of the resistor body must be centered exactly on the horizontal guide when you draw them (see the figures) or they will look crooked when the zoom is reduced to 100%.

- h) Copy a second pad and nudge it into place.
- i) When you have the design correct, group the figure together.
- j) Copy the resistor outline to the template slide and view it at 100% zoom against the array. You may find one or both pads not centered in the gray background hole.
- **k)** Ungroup the figure and adjust the size of one or both pads so that each pad is centered as well as possible against the correspond-

ing hole in the array.

 Regroup the figure and look at it again at 100% against the array.
 You can go back to high magnification and tweak again, if necessary.

Figure 11 shows how to create the same figure, but oriented vertically.

a) With the zoom at 400%, copy the horizontal resistor and rotate it right. In my experience, rotating will distort the copy slightly.

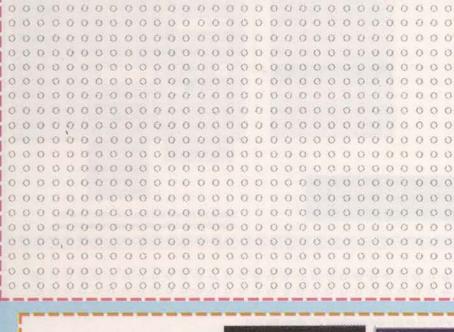
b) Ungroup the copy.

- c) Re-size the pads and lines slightly to make the figure symmetrical and re-group it.
- **d)** View the figure against the array at 100%. Repeat a) through c) if it still isn't perfect.

The outlines we have created so far fit on holes .40" apart. Disk and dipped mylar capacitors would likely be the next most common components on a typical board, right? Since many types fit the same profile as a resistor, create an outline for a capacitor of that size as shown in Figure 12.

a) Center a standard pad on

Figure 8 - The Array



0000000000000000000000000000000000

P X Draw Window Help Scale To 1 章 次 E Steletive to Dingmed Playing Skie Bring to Front Elest Scale for Slide Show Preview Send to Rack Besalutian 12 Bring Forward With Snap To Grid on, once again draw the smallest circle you can. Send Backward Turn the Snap Off. Snap to Grid Figure 9 -Create A Standard Pad Using the scaling feature, reduce the figure to 84% of original size. c. Move the result to the area of the template slide where you want to keep your "library", and label it. Standard Pad O 00000 00000

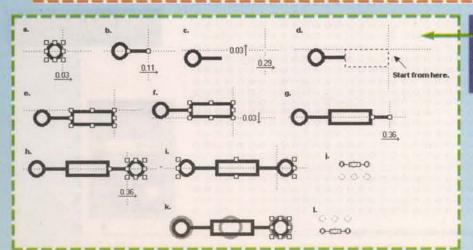


Figure 11 — Vertical Resistor Outline

Figure 10 - Draw A Resistor

0 H, 0 V and bring a line out to .11" right.

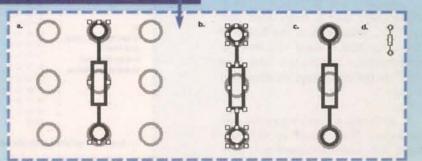
- **b)** Set the guides as you did to draw the resistor body: vertical guide at .29" right and horiontal at +.03".
- c) Starting from the intersection of the guides, draw an ellipse back toward the connecting line.
- d) The result should look like this.
- e) Move the horizontal guide back to zero and make sure the ellipse is centered. If it isn't, I found that the best way to adjust it is to resize it slightly from the center handle.
- f) Finish the figure as you did the resistor with a connecting line and another pad.
- g) Group the figure, copy to the template and view it against the array. Tweak the size, if necessary.
- h) View the figure at 100%. If it looks good, copy it to the library.
- As you did with the resistor, make a vertical outline by rotating to the right a copy of the original figure. Ungroup the copy.
- j) Adjust the sizes of individual elements and regroup the figure. Copy to the library.
- k) You will certainly need a capacitor outline .30" long at some point, so try drawing one to these dimensions. Again, create a vertical copy as well. For the template in Figure 1, I also created and added outlines on centers of .20" and .50".

Tubular capacitors come in many footprints. I looked at a couple of types in my stock that I expected to use a lot and drew the basic outline shown in Figure 13. These particular items looked like they would take up .20" or so of board width; if yours are wider or narrower, take this into account. I kept a piece of perfboard handy while drawing and used this as a gauge for estimating footprints.

Unless you have a 19" monitor, your library of outlines will outgrow the border of the template at some point. When this happens, you may want to expand the library to a separate slide.

If you have stayed with me and drawn everything so far, you should have four outlines for tubular capacitors — two horizontal and two vertical. Many axial electrolytics will fit the same profile, but they need polarity markings. Try this:

Select all four tubular capacitor outlines and duplicate. Move the



### POWERPOINTING · POWERPOINTING · POWERPOINTING · POWERPOINTING · POWERPOINTING

copies to another area of the library and label them "Axial Electrolytics." Now see Figure 14.

- a) At 400% zoom, ungroup any capacitor outline.
- b) Create two text boxes. One should contain a plus sign and the other an underscore character (I found that this makes a better negative terminal indication than the usual minus sign). For the signs that go inside .20" wide outlines, I set the font to Arial 8 point bold. Make each text box as small as the program will allow.
- c) Make copies of the text boxes, position the copies carefully within the capacitor body and regroup the figure.
- d) Now add polarity markings to the other capacitor outlines. I also put copies of the + and - signs in the library for future use.

Radial electrolytic capacitors come in a gazillion values, but you can accommodate the smaller, most common ones with a relatively few outlines. Figure 15 shows how to create the smallest one, on .10" centers.

a) At 400% zoom, create two standard pads centered at 0.00 and

> Figure 17 — Drawing A 16-pin DIP

.10" right.

- b) Move the vertical guide out of the way. From approximately the point shown, draw a rounded rectangle (in the autoshapes) downward and to the right. (I found it easier to eyeball this than to use the vertical guide, and I chose this shape rather than a circle to distinguish the body from the pads.)
- c) Adjust the width of the body on both sides of the horizontal guide. As shown here, its vertical sides should just butt against the sides of the pads. Give it white fill and the thinnest line style.
- d) Create a text box with the + symbol in Arial 7 point bold, position as shown, and group everything.
- e) Copy this figure to the template and view it against the array, first at 400% and then at 100%. I wasn't happy with the symmetry, so I went back to 400% zoom, ungrouped the figure, squeezed each pad slightly smaller and regrouped.
- f) This was the result. Again for the sake of later convenience, duplicate the

symbol several times and rotate the copies to orientations that you might want to use later.

**g)** You might want to add similar outlines drawn on .20" and .30" centers.

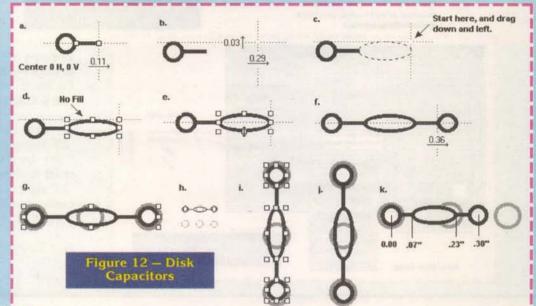
Our last job before we can use the template is to draw some DIPs, starting with a 16-pin. From that, we can easily hatch 14- and 8-pin versions.

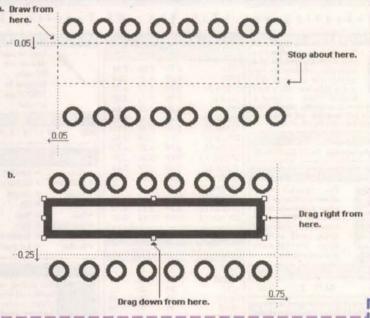
See Figure 16.

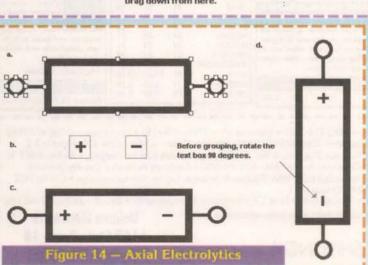
a) Start by again locating a

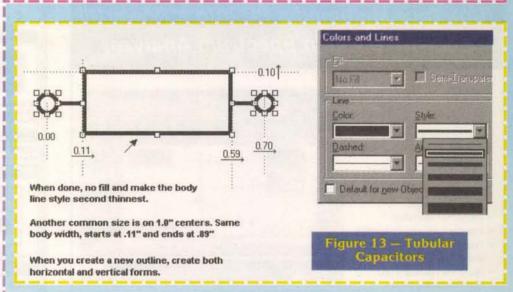
standard pad at 0 H, 0 V.

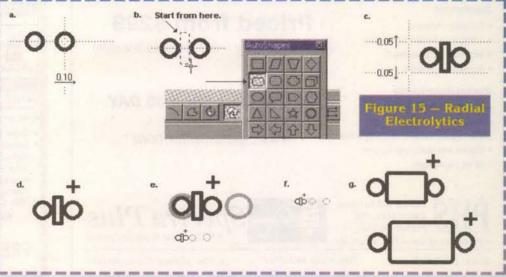
- b) Move the vertical guide to exactly + .10" right. Duplicate the first pad, center the copy at 0 H, + .10" right, and leave it selected. Move the vertical guide to + .20" right, duplicate again, and another copy will show up close to +.30" right. Nudge this copy into position.
- c) Continue creating pads until you have a line of 8. When you have the line complete, group it, and then duplicate it.
- **d)** Lower the horizontal guide to .30" below zero. Move the copy into place, ungroup it, and correct the

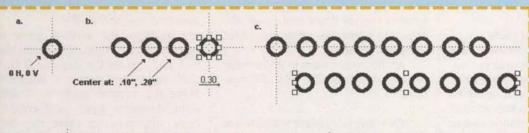






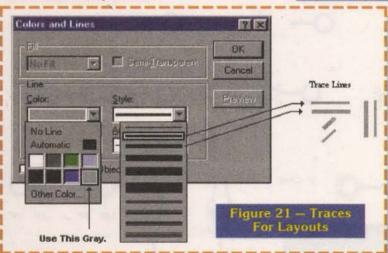






00000000 000000000

Unselect all and correct positions individually as needed.



See Figure 17.

done

positions of individ-

ual pads so that

they are parallel and

centered .10" apart.

line when you're

e) Group the

a) To create the body of the DIP, position the horizontal guide at .05" below zero and the vertical guide at .05" left of zero. Draw a rectangle, moving downward and to the left as shown.

stopping a little more than half way to the lower line of holes and short of the outer edges of pad numbers 8 and 9. Give this rectangle No Fill and the second thinnest line style.

b) Lower the horizontal guide to .25" below zero and drag the center lower handle of the rectangle to meet it. Move the vertical guide to .75" right of zero and drag the right center handle of the rectangle to meet it.

See Figure 18.

a) The resulting rectangle

should look like this.

- b) Unselect the rectangle. Restore the vertical guide to 0.00 and set the horizontal guide at exactly .03" below zero.
- c) From just inside the top edge of the body to the horizontal guide, draw the first connecting line. Adjust the size and position so that the line appears as you see it here. In particular, the lower handle of the line should not extend into the white space of the pad. If this seems too finicky, remember that we will be reducing the size of the figure a lot; if you want a clean outline with no misplaced or distorted lines, care now is essential. When the line looks correct, leave it selected.
- d) Move the vertical quide to .10" right, and duplicate the first line (CTRL - D). Nudge the copy into place with the arrow keys.

See Figure 19.

- a) Keep moving the vertical guide, duplicating the previous line and nudging each successive copy into place.
- b) Go through the same process with the lower line of pads.
  - c) This is the completed figure.
- d) To mark pin 1, position a standard pad as shown, with the left side of the DIP body making it effectively a

## Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

### Features

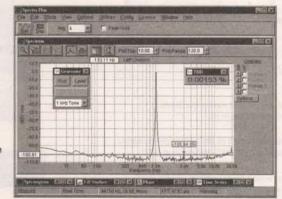
- . 20 kHz real-time bandwith
- · Fast 32 bit executable
- · Dual channel analysis · High Resolution FFT
- Octave Analysis
- · THD, THD+N, SNR measurements
- Signal Generation
- . Triggering, Decimation
- · Transfer Functions, Coherence
- · Time Series, Spectrum Phase, and 3-D Surface plots
- · Real-Time Recording and Post-Processing modes

### **Applications**

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- · Acoustic Research

### System Requirements

- 486 CPU or greater
- . 8 MB RAM minimum
- \* Win. 95, NT, or Win. 3.1 + Win.32s
- . Mouse and Math coprocessor
- . 16 bit sound card



## Priced from \$299

(U.S. sales only - not for export/resale)

### DOWNLOAD FREE 30 DAY TRIAL!

www.spectraplus.com

Pioneer Hill Software Poulsbo, WA 98370 24460 Mason Rd. a subsidiary of Sound Technology, Inc.



Sales: (360) 697-3472

Fax: (360) 697-7717

e-mail: pioneer@telebyte.com

### Celebrating our 17th Year Of Service II

## COLLIMATING LENS This economical collim lens assembly consists black anodized aluminum

1-9 10-24 25+ LSLENS Lone Assembly 24.99 23.74 21.37

## DIODE/TRANSISTOR TESTER KIT



This dynamic tester allows checking of transistors & diodes in circuit. Identifies NPN or PNP transistors. Checks all types, small or large power. Identifies anode

STOCKS	14	10-34	25+
DT100K	24.99	23.74	21.37

ANTI-STATIC FOAM CLEANER

A thick, foaming cleaner for use in static sensitive applications. Safe for plastics and fiberglass

SOUR	14	10-24	25+
\$81102	1.99	1.89	1.70

		EPRON	13	
9	STOCES	1-M	25-99	100+
2	2716	2.99	2.84	2.56
	2732	4.49	4.27	3.84
4	2732A-20	5.49	5.22	4.70
1	2764-20	5.39	5.12	4.61
0	2764-25	4.49	4.27	3.84
0	2764A-20	3.49	3.32	2.99
	2764A-25	2.99	2.84	2.56
No.	27C64-15	2.99	2.84	2.56
7	27256-15	4.79	4.55	4.10
	27C256-15	2.99	2.84	2.56
-	27512-25	3.09	2.94	2.65
ı	27C512-25	2.99	2.84	2.56
-	27C010-15	2.79	2.65	2.39
- 1	27C020-15	3.49	3.32	2.99
	27C040-12	5.49	5.22	4.70
P	27C080-12	10.99	10.44	9.40
H		Series III		
aŀ	0	and person	100	100

Popular I.C.'s				
STOCES	1-21	25-49	100+	
7400	.39	.37	.33	
74LS00	.19	.18	.16	
4017	.29	.28	.25	
7805T	.33	.31	.28	
7812T	.33	.31	.28	
LM317T	.49	.47	42	
LM386N-1	.33	.31	.28	
NE555N	.24	.23	.21	
LM741N	.24	.23	.21	
NE5532N	.55	.52	.47	
68HC705C8P	8.99	8.54	7.69	
8749	17.99	17.09	15.38	
62256LP-10	2.79	2.65	2.39	
2014	2 70	245	2.20	

-	2614	1 6 6 11
	FM MICR	OPHONE KIT
6 4 70	1	Transmit your voice on any FM radio. Range up to 1000'. Case included

15.99 15.19 13.67

## What Do We Have?

- · LC's Canacitors Oscillo
- CrystalsDiodes · Trimpots
- · Took · Vises · LED's
- · Vises

### GADGETEER'S GOLDINE This exciting col-lection of elec-tronic projects

features experi-ments ranging from magnetic levitation and lasers to high tech surveillance and digita

 By Gordon McComb 14 10-21 25+

Order Line — (800) 824-3432 • International — (724) 495-1230 • Fax Orders — (724) 495-7882 Technical Support — (724) 495-1231 • No Minimum Order – (Orders under \$20 subject to \$5 charge) • UPS 3 day, Blue, Red, & Fed. Ex. Shipping Available (Call for charges) • PA Res. Add 7 % Sales Tax • Open Mon-Fri 9:00 AM - 5:00 PM (EST) • Corporate Accounts / Quantity Discounts Available • We accept M/C, VISA, Discover & American Express with no surcharge • Call For FREE Catalog (\$2.00 Outside U.S.)

We Carry A Complete Line Of Electronic Components • Email - unielect @ aol.com Visit us on the web! www.unicornelectronics.com

FREE SHIPPING!! on pre-paid orders

Unicorn Electronics 1142 State Route 18 Aliquippa, PA 15001

half-circle.

See Figure 20.

a) Ungroup both lines of pads, and select everything. Group the whole figure together.

b) Copy the result to the template. reduce zoom to 100 percent, and see what the outline looks like. I went back to 400 percent. ungrouped the | outline, and adjusted the positions of a few items to get the result shown. The result can go in the library.

c) To get a 14-pin DIP, make a copy of the 16-pin outline. Ungroup it and remove pins 8 and 9.

d) Reduce the width of the body and regroup.

e) In a similar way, create an 8-pin DIP.

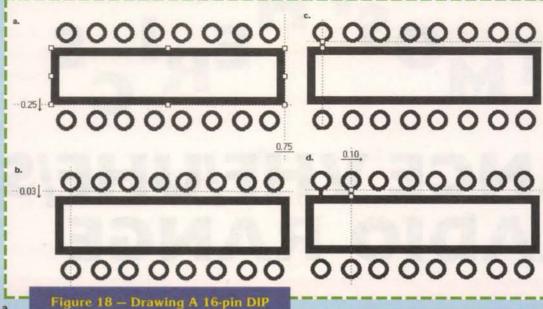
I know it's been a lot of work, but if you have gotten this far, you have learned all of my tricks for getting things correctly sized and positioned.

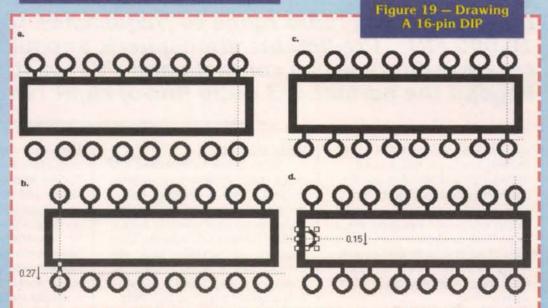
Since at some point you will surely need to position a DIP rotated 90 degrees, use the method I have described to create a 16pin DIP in this orientation and then "hatch" 14-pin and 8pin versions.

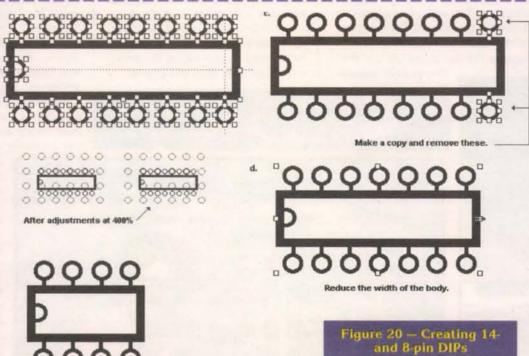
When you use these versions, you can decide on the spot whether pin 1 is upward or downward and add the indicator accordingly

Figure 21 shows some typical trace lines used for layout and how to create them. We are ready to draw some PC board patterns!

Next month, we will design a PC board for the circuit whose schematic we drew in Part 1, turn the artwork







into a finished board, and end up with a useable project — a horn for a child's bike.

If you would prefer the convenience of starting with a copy of the template shown in this article, I will E-Mail to you a PowerPoint 7.0 file.

Send your E-Mail address with a check or money order for \$10.00 to: Small Bear Electronics, 123 Seventh Avenue Suite 156, Brooklyn, NY 11215. You can E-Mail me directly at smallbearelec@ix.netcom.com.

See you next month! NV

### **PICmicros & BASIC**

PicBasic Compiler - \$99.95 PicBasic Pro Compiler - \$249.95

Now it's even easier to program the fast and powerful Microchip PICmicros. The PicBasic and PicBasic Pro Compilers convert your English-like BASIC

r OL

programs to files that can be put directly into a PICmicro. True compilers for faster, longer programs. BASIC Stamp<sup>TM</sup> I/II\* libraries. For mid-range PIC12C67x, 14Cxxx, 16C55x, 6xx, 7xx, 8x, 87x, 9xx and high-end 17Cxxx (PicBasic Pro only).

\*BASIC Stamp is a registered trademark of Parallax Inc

New! PIC-X1 Experimenter/ Lab Board

Assembled - \$199.95 Kit with parts - \$139.95 Bare PCB only - \$49.95



### EPIC Plus PIC Programmer - \$59.95



Programs PIC12C5xx, 67x, 14Cxxx, 16C505, 55x, 6xx, 7xx, 8x, 87x and 9xx. Optional ZIF adapters for DIP, SOIC, MQFP, PLCC.

Runs off two 9-volt batts or optional AC adapter Includes programming software and assembler.

### PICProto Prototyping Boards

Get it wired quicker! High-quality blank prototyping boards for PICmicros. Holds PICmicro, 5V reg, caps, oscillator, DB9-25, large proto area. \$8.95 - \$19.95



### micro Engineering Labs, Inc.

Box 7532 Colorado Springs CO 80933 (719) 520-5323 (719) 520-1867 fax http://www.melabs.com

Write in 146 on Reader Service Card.



The RF Connection 213 North Frederick Ave. Suite 11NV Gaithersburg, MD USA 20877

http://www.therfc.com/

Complete Selection of MIL-Spec Coax, RF Connectors and Relays

UG-21B/U N Male for RG-213/214......\$5.00 UG-21D/U N Male for RG-213/214......\$3.25

N Connectors for 9913/Flexi4XL/9096

UG-21B/9913....\$6.00 Pins Only.....\$1.50 UG-21D/9913....\$4.00 Extra Gasket.....75

Amphenol 83-1SP-1050 PL-259 .......\$0.90 UG-176/U Reducer RG-59/8X . .25 or 5/\$1.00 UG-175/U Reducer RG-58/58A .25 or 5/\$1.00 Silver Teflon PL-259/Gold Pin .....

.....\$1.00 or 10/\$9.00

MIL-Spec Coax Available (Teflon, PVC IIA)

Also New: 9092, RG8X with Type II Jacket Intro Price \$23.00/100ft

Call for Specials of the Month

Full Line of Audio Connectors for Icom, Kenwood, and Yaesu

8 Pin Mike Female	.\$2.50
8 Pin Mike Male Panel	.\$2.50
13 Pin DIN for Kenwood	.\$2.75
8 Pin DIN for Icom	.\$1.00
8 Pin DIN for Kenwood	.\$1.50

### Prices Do Not Include Shipping

Orders 800/783-2666 Info 301/840-5477 FAX 301/869-3680

# ENHANCE VHF/UHF/SHF RADIO RANGE

his is one of the few times of the year that we can truly blame the weather on how well we receive VHF FM and TV radio signals over extended paths. We can also blame the weather on unusual radio occurrences where the Miami Police Department responds to a call that was really directed to a Galveston, TX traffic unit. We can also blame the atmosphere for the Chicago VHF weather station drowning out the local NOAA transmissions in Virginia Beach. And you can imagine the surprise of United States Coast Guard station Long Beach, CA answering a call for a tow from a sailboat that ran out of wind 2 miles south of Hilo Harbor,

And now for the super-weird, thanks to the September and October atmosphere - beachgoers in Tampa watch a freighter go

There is no coincidence when summer and fall weather bring enhanced radio range to frequencies 100 MHz to 10,000 MHz. Predictable atmospheric anomalies may create radio two-way contacts and TV reception well beyond the normal 4/3 radio line-of-sight range.

by on the horizon, UPSIDE DOWN! In Alaska, offshore oil drilling rigs look like they are on one-mile-high stilts. And in New York, air traffic controllers wonder if their equipment has gone snafu when close-in airplanes are barely seen at all, and outbound aircraft hundreds of miles away continuously stay locked into their screen.

This long-range radio phenomena begins to affect frequencies from 100 MHz, and higher. It is technically atmospheric superrefraction where signals go well beyond the 4/3 radio horizon for

Other terms for extended VHF range may be called tropospheric ducting, inversion ducting, and inverted mirage communications. These long-range contacts have EVERYTHING to do with the local weather, and NOTHING to do with the ionosphere. While sporadic-E ionospheric skip COULD affect frequencies as high as 300 MHz, the ionospheric skip for longrange VHF contacts may only last for a few minutes to - at most a few hours, and signals fluctuate in strength rapidly. In contrast, local weather conditions triggering a tropospheric duct will create

enhanced VHF and UHF plus microwave long-range radio and TV conditions for six to eight hours, and sometimes three or four continuous days, with almost no fluctuations in signal strength.

The VHF, UHF, and microwave line-of-sight range is usually considered 4/3rds the optical path. In other words, radio waves will take a natural bend beyond normal line-of-sight to the horizon. This occurs because of the refractive index of normal air, abbreviated "n," which is around 1.000310. Consider the lower case "n" as normal air. But during the summer months and early fall, the air above us sometimes gets very ABNORMAL! Warm air may override cool air, and windless days may create air stratification that can be easily seen as smog and

> dirty air simply hanging on the horizon. Air stratification can also be seen as smoke that rises. and then abruptly tops out horizontally.

> When we have stratification of different air consistencies and densities, the refractive index may change abruptly. If the refractive index change is sharply pronounced, VHF-and-higher frequencies may be super-refracted over

California Tropo. Below tropo is seen hanging over the Los Angeles basin. Pictured is Chip margelli K7JA.





extremely long distances. And since this occurs in the troposphere, the word "tropospheric ducting" appropriately describes how extremely short wave lengths travel within the tropospheric duct, much like a wave guide.

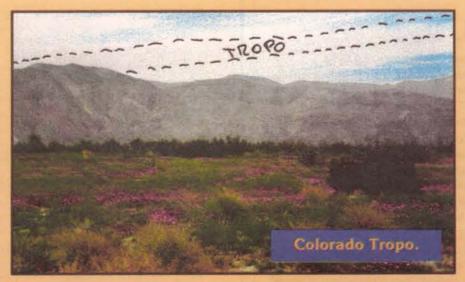
Long-range VHF/SHF ducting occurs over regions sitting under the effects of a high-pressure system. When you have a cell of high pressure that stalls out, the extra weight of the air aloft in the high will begin to sink. This SUBSI-DENCE of air compresses into a band of hot air that overlies cool surface air at ground level. If the boundary between cool air below and the sandwiched warm air exceeds a 10-degree F temperature change, this may be enough to trigger long-range VHF/UHF/microwave ducting over hundreds, and sometimes thousands, of miles.

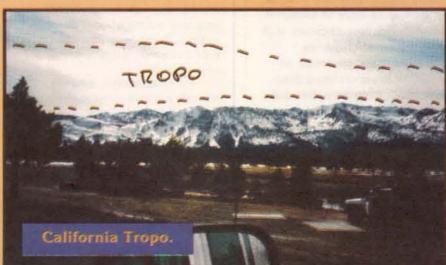
> California Hawaii high Bermuda Azores high The Australian high South America Africa high

And I'm happy to say, in late summer and fall, the stationary high that many times stalls out over the mid-US, leads to some exciting 1,000-mile tropo ducts!

Well-respected atmospheric expert, Bruce Eggers WA9NEW, further explains what might happen below a stationary high-pressure system triggering the radio

The formation of a duct is the result of the physics of the fluid. Any combination of parameters which contribute to a sufficiently thick layer of superrefractivity causes ducting. And a sufficiently thick super-refractive layer, such as to minimize losses through the top and of sufficient altitude so as to minimize losses at the surface, causes a field strength attenuation





nearly proportional to 1/r rather than 1/r2. Hence, under ideal ducting conditions, a signal from a transmitter 5,000 miles away has the same field strength as an identical transmitter only 70.7 miles away, assuming all else equal and "line of sight" propagation. Common are frontal layers and early morning radiational cooling of the lower layer of the atmosphere. Transpacific tropospheric ducting is well documented, too.

Eggers also talks about the

Bermuda high and good reason to believe that some of the infamous Bermuda triangle aircraft/ship losses may well have resulted from the same kind of anomalies communications problems.

Within the duct, the big refractive index change is from pressure, temperature, and water vapor content. Within the duct, a sharp increase in temperature occurs. Relative humidity that normally decreases with altitude may sharply increase within the duct. Here on the Pacific Coast, hurricanes to our south may contribute to trapped warm moist air feeding

the duct. And within the duct. pressure may rise, rather than fall with altitude. And once the duct forms up, expect some surprising short-range radio communications that will extend over some longrange paths!

- · VHF/UHF and microwave from California to Hawaii
- · Microwave from Australia to New Zealand
- · VHF and UHF path between Nova Scotia and Miami
- · Television reception between Chicago and Texas
- Microwave contacts from the Midwest to the East Coast

For those of you with cell phones, you may experience enhanced coverage to distant areas you couldn't normally access before. If you are into scanning, your programmable scanner will start picking up calls on local frequencies that you might not have ever heard before. And if there are some hills near you, drive up to within the duct and have a virtual pipeline of scanning excitement. And how do you know you are within the duct? Hot smoggy air, temperature increases, the air smells musty, and your car's altimeter may show you going down when you are actually going up!

If you are into television DXing with an outside antenna, tune those channels that are not local, and watch typical snow turn into full color TV with audio. And just when you thought you had your direct satellite dish pointed exactly at the right spot, severe tropospheric ducting episodes may cause your signal to freezeframe, and you may need to go out and tweak your little portable dish to improve the incoming signal during the ducting episode.

Some good 24-hour "beacons" to alert you of enhanced VHF radio conditions might be

## Super-Small-Low Power

The NEW UNI-MICRO series of modules provides a complete ready to use single board computer on a 1.75" X 1.5" module with large amount of non-volatile flash based memory. Expanded capabilities, multiple serial busses, in-circuit programming, including first time programming and a very low power consumption of 58 mA, makes this series of modules perfect for instrumentation, monitoring and control applications.



### Microcontroller Design Made Simple

Small \* 80C51 code compatible \* 256 x 8 ram \* 2K x 8 Battery backed sram with automatic por switching \* 128K x 8 Flash memory \* Parallel or serially programmable \* 32K x8 Flash memory 3 18 bit timers \* One 8 channel 10 bit A/D converter \* Two 8 bit PVM outputs \* One full duplex UART \* 16 Mhz speed \* 3000 gates flash CPLD \* IIC serial bus \* JTAG bus \* 54 configurable I/O pins \* RS232 driver on board \* Voltage regulator on board \* Power-on rest Program security \* Very low development costs \* Asembly, C , Basic programmable.

OS Systems

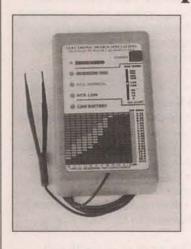
908-979-1885 http://www.ossystems.net 1464 Route 57th, Port Murray, NJ 07865

THERE IS A FREE LUNCH AFTER All - 500 resistors sent absolutely free with order of \$10.00 or more. Sell them to your friends for 1¢ or 2¢ and treat yourself to a \$5.00 or \$10.00 lunch! Spend \$25.00 and we'll send 1,500 (Lunch for 2).

ER Digital Multimeter         \$17.95           ER Analog Multimeter         6.95           SO-239 Connector         .95	1N4005 (600V-1A) (100) \$4.95 1N914 (75V-10mA) (100) 2.95 1N4148 (75V-10mA) (100) 2.95
PL-259 Connector	2N3904 (NPN) (100)
10 Pair Alligator Clip Leads 2.95 10 T 1 3/4 LEDs (green, red, yellow) 1.25	2N3906 (PNP) (100)
12V - 60Amp Starter Switch. 9.50	2N5239 (NPN) HV GP Amp
Pocket Telescoping Magnet	2N5684 (PNP) 50A-300W Hi-Pwr Amp
40-pc Carbon Steel Tap & Die Set	2N5686 (NPN) 50A-300W Hi-Pwr Amp
AA Ni-Cad Battery	Set of 4 Wax Carvers/Picks
1# 60/40 Solder	6" Plastic Vernier Caliper
30W Solder Iron	Pad of 56 Stick-on Feet
XLR-3 Pin Male Connector	4" Black Tie Wraps (100)
Mini Toggle Switch SPDT On-Off-On	12-1/2W - 1.5K Rheostat
Mini Toggle Switch DPDT On-Off-On	50V-2A Bridge Rectifier
Full Size Toggle DPDT 15A-3/4 HP 2.00	2-Way Splitter (5-900 MHz)
3-Wire Trailer Connector (M&F)	RJ45 Connector
4-Wire Trailer Connector (M&F)	Banana Plugs (Red or Black)
Mini Snap-in Rocker Switch 6A	Universal 1 Amp AC/DC Adapter
1N4001 (50V-1A) (100)	with 7 Different Voltages
Add \$3.50 for shipping and handling	

HYATT ELECTRONICS, 371 N. Johnson Ave., El Cajon, CA 92020 Tel. (619) 444-2434 • Fax (619) 444-1987

## Don't be stupid.



Smart techs know that to be productive you need to find defective components quickly. Maybe that's why 37 TV stations, General Motors, Matsushita Industrial. Sears Service. Pioneer Electronics. Panasonic Authorized Service, and thousands more independent service technicians have chosen the CapAnalyzer 88 over all of the other capacitor checkers. Check www.eds-inc.com/88users.html for actual CapAnalyzer users' comments as they compare their CapAnalyzer to the "wizards" and "z-meters" they already own. They all prefer the CapAnalyzer 88 because it

does what you expect it to do: check electrolytic capacitors, in-circuit, with 100% accuracy. Period. No unsoldering to check out-of-circuit, no mistaking a shorted or leaky cap as good, as other "ESR" meters do, no guessing about whether a value is good or bad. With our exclusive threecolor chart right on the front panel, auto-discharge, multi-beep alert, and one-handed tweezer test probe, even your pet monkey could find defective caps in that problem TV, monitor or VCR in a few seconds. 55% of sales of CapAnalyzers are from recommendations by other CapAnalyzer owners, and 9% of sales are from previous customers buying a second unit. So get smart and buy one for yourself. It's only \$179. With our exclusive 60-day satisfaction-or-money-back guarantee, you risk nothing. Your only problem will be running out of work as you take care of all of those "dogs" that you've been sitting on. We're EDS. We make test equipment designed to make you money. Availiable at your distributor now. 561-487-6103

www.eds-inc.com

Write in 172 on Reader Service Card.

# Serial in, graphics out. Almost too easy.

These serial displays take RS-232 at 2400 or 9600 baud and produce stunning text and graphics on a supertwist LCD screen. See our complete line at www.seetron.com. All models are in stock for immediate delivery.

G12032 120x32-pixel LCD SGX-120L \$99.00

Same size as 2x16 text LCD Editable font(s) in 4 sizes Up to 6 screens in EEPROM Easy terminal protocol



(3.2 x 1.4 in.)



G12864 128x64-pixel LCD \$199.00 BGX-128L-1

Large, sharp LCD Editable font(s) Up to 14 screens in flash Separate text, graphics layers DB9 connector built in AC adapter jack built in Easy terminal protocol

(3.7 x 2.8 in.)

www.seetron.com

Scott Edwards Electronics, Inc. ph 520-459-4802 fx 520-459-0623 nnv@seetron.com

unused VHF weather channels in your area:

> 162.550 162.400

162.475

162,425

162.450

On UHF, try scanning 460.000 MHz to 460.500 MHz, and tune in distant public safety transmissions. And up on the higher frequencies, try and score the trunked radio sounds around 856.4625 MHz; a public safety frequency that is permitted for legal scanning.

Ham operators throughout the country will tune into VHF and UHF propagational beacons in the CW mode. These can be found around 144.280, 432.075, and 1296.0.

Communication distance records are quite impressive from ham radio tropo contacts:

> 144 MHz: 4,333 kilometers 432 MHz: 4,142 kilometers 903 MHz: 4,061 kilometers 1296 MHz: 4,142 kilometers

2304 MHz: 3,973 kilometers 3456 MHz: 3,973 kilometers 5760 MHz: 3,973 kilometers 10,000 MHz: 1,124 kilometers

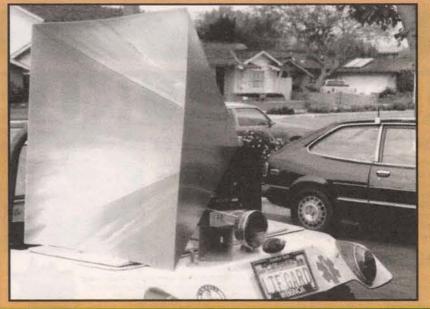
Many of the tropo records are held by Paul Lieb KH6HME, the recent recipient of the technical award at the recent Dayton Hamvention™. Paul is in Hawaii on the side of the Moana Loa volcano, and he regularly communicates on VHF, UHF, and microwaves to ham operators along the Pacific Coast as far north as Washington. Paul and I hold a one-way distance record for amateur television over that path, too.

So, stand by this fall for exciting tropospheric ducting conditions. Watch your weather maps for a stalled high-pressure system sitting over you and a distant city that you might easily tune in on VHF or UHF. During periods of hot windless days with smog hanging on the horizon, get set for some extraordinary radio conditions that go well beyond line of sight on VHF frequencies, and higher. NV

five watts on 434 MHz to Hawaii on these cubical quads (right).

Gordo's big 10 GHz system ready for more Hawaii tropo (below).





# Automatic Night LED (With Other Worthwhile, Associated LED Projects)

by Evert Fruitman W7RXV

any older people can remember some of the exciting things they did when they were young, like sneaking a flashlight into the bedroom at night so they could finish reading a thrilling book after "lights out." Even if they managed to put back the flashlight without getting caught, the seemingly short battery life may have aroused suspicions as to what had happened

With the advent of the white Light Emitting Diode (LED), you can have almost as much excitement without having to worry about running down the batteries, or a trip to the woodshed. You can also make several useful, practical, portable lights.

One of the many space-age spin-offs that we enjoy, even take for granted, LEDs gave designers a reason for excitement. They had at their finger tips a cold, low voltage, low current light source. Too bad that the early LEDs also had relatively low light output. As the technology advanced, it became possible to get brighter red, as well as brighter yellow, green, orange, and blue LEDs. Although the price of these LEDs dropped and the light level went up, they still gave off only their own, single color.

These LEDs found use in toys, and as pilot lights, warning lights, key chain lights, and several other practical applications. However, their single color output limited their uses. For example, a small key chain light could help you find a lock in a dark location, but you would not want to read with only a yellow or a green light. Someone finally got around to making a white LED, and letting the public know about it. That LED can do all of the tasks just mentioned. and it gives a good, bright, useful light. We will look at several ways to make use of those white LEDs, plus a couple of uses where you can substitute the ultra bright, jumbo LEDs.

With the white LEDs, you can make a flashlight suitable for carry-

ing in your pocket, purse, or backpack. You can make a very portable, low power, long life, but practical read-

ing light. With or without a few modifications, you might want to take it camping. I have used it for reading in the back seat of a car on a long trip after sunset. It sure beat looking at the back of the front

The white LEDs also lend themselves to a small beacon. You can use either the white LEDs or the extra bright, jumbo red or orange LEDs for an attention-getting light on the back of your backpack or on the back of your bike. Price and availability help in part to determine which LED you might choose.

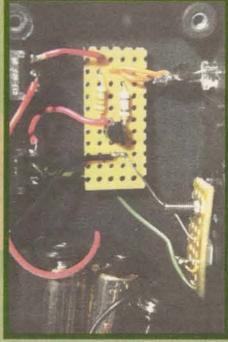




### **РНОТО С**

Automatic Night LED, Rear View Practical version, if you do not run a lathe. In the AUTO mode, will turn on/off depending upon ambient light.





### **How Much Light?**

A small, two-cell penlight gives a lot of useful light. However, you can get or make a practical penlight with LEDs. Sporting goods stores sell them. The \$35.00 plus shipping and handling.

The first white LEDs that I found cost web has ads for white LED flashlights for about

just under \$10.00. Several of my camping friends thought that they would make a great light for them, even at that price. Since then, I have found some for about \$4.00 each; less if you and some friends want to get together to buy

10 at a time. The two types give comparable results: light vs. current consumption. For particulars on where to get them, look in the parts list.

home construction, either.

For comparison, a two-cell penlight will light up the other side of a normal size room, while the LED lights that I have made need to get close to the far wall for the same amount of reading light. Either that, or put a magnifying glass on the front of the light and focus the light. That does work at the expense of a narrower light beam. A pair of the white LEDs makes a good reading light without a focusing lens. We will decide what we need in the construction section.

### **Power Drain**

The typical two-cell penlight will have a lamp that draws close to 300mA, 0.3 amps, at 3 volts. That figures out at just under one watt: 0.9W. These

### PHOTO D

Automatic Night LED, Interior view
Top left: ON/OFF switch. Mid Left: AUTO/MANUAL switch.
Center: circuit board with base bias resistor on the upper left, 68 ohm current limit resistor upper right, transistor lower center. Upper right side of box: LED. Lower right side of box: crude but effective way to mount the photocell.

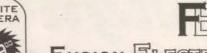


COLOR CAMERA

BLACK & WHITE



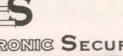
350 LINES



## FUSION ELECTRONIC SECURITY

1-800-323-8746

WEBSITE : WWW.FUSIONELECTRONICS.COM





BLACK & WHITE





COLOR MICRO DIGITAL (WITH DSP) 350 LINES 32 MM X 32 MM 2 LUX \* PINHOLE LENS 151: 456P

E-MAIL : FUSION@FUSIONELECTRONICS.COM 1376 NW 22 AVE. MIAMI, FL 33125 TEL (305)635-7060 FAX (305)635-3175

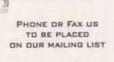






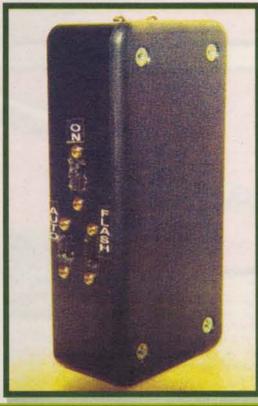


PIR CAMERA 420 LINES









### PHOTO E

Automatic Night LED, Beacon Switches on back, photocell on the top.

You may set the switches for steady light, automatic light, or automatic blinking beacon. Hang it in your tent or car. Put it in the steady mode and place it on a table in front of a book while camping, or just use it as a flashlight.

LEDs must not have more than 25mA, 0.025A through them. They will have a nominal 3.6 volts across them. The arithmetic shows that as 0.09W; about one-tenth the power of a regular penlight. Still, a one or two LED lamp makes a practical, long life light. Expect 30-50 hours battery life.

### How To Power a LED

Light emitting diodes, like many other semiconductors, have to have a certain minimum voltage across them before they will start to pass a current. A common power diode, such as the 1N4007 must have about 0.5 volts across it, or it will not allow current through it. Under normal operating conditions, that diode will have about 0.6-0.9 volts across it. Once the power supply exceeds that voltage limit, there must be a current limit or the diode will overheat, which usually results in its destruction. Some of the more common LEDs will have about 1.2-1.8 volts across them during normal operation. You will find these ratings on the package.

Due to the nature of their construction, LEDs need more voltage than do small, power supply diodes. Again, once the diode starts conduction, it must have a current limiter or you will have a dead LED. Under certain conditions, you may exceed the ratings on the package for special effects, but that takes special circuitry.

For example, most LED readouts have extra high current pumped into them for a fraction of a second at a time. That gives a bright display without wasting a lot of valuable board space with current-limiting resistors. That also keeps from wasting power in the series resistors. But, it takes more com-

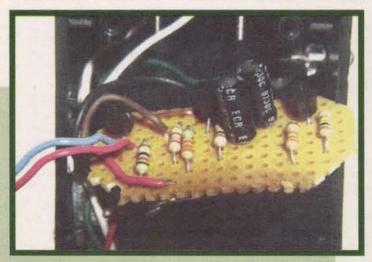
plex circuitry than we want or need here. One package lists the LED current as 25mA continuous or 80mA peak. They did not say how long the peak could last.

The white LEDs need around 3.6 volts to give their panchromatic light. I have seen people place a red LED across a battery without a current limiting resistor. They just happened to get the right battery voltage for their particular LED. It did not fully turn on the LED. Figure 1A shows the more common way of connecting a LED to a power source.

The values given are for a white LED with its higher voltage drop. If you want to make a basic, bare-bones LED light with the lower voltage LEDs, use a threevolt battery or increase the value of R1 to 150-220 ohms for the battery shown in Figure 1.

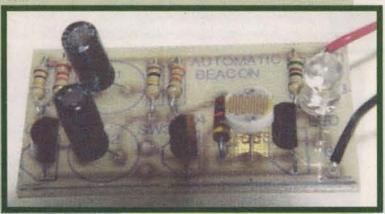
### Something Special

By adding a transistor and its bias resistor to the basic circuit, you have a convenient way to



### PHOTO F

Automatic Night LED, Beacon, Interior view Left side of board: driver transistor for LED. Center: timing capacitors. Right side of box: LED. Prototype board.



### PHOTO F1

Automatic Night LED, Beacon

The clear silkscreening on the PCB makes it easy to see what parts go where, even without a diagram. In this version, the photocell is mounted on the board rather than on the side of the box. Switch wires added after the photo session.

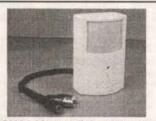
> control the current through the LED. Add a photocell to the circuit as shown in Figure 1B, and you have an automatic night LED. Let's take a look at



CONVERTS PC MONITOR to SECURI-TY MONITOR. The VGA-801 accepts standard NTSC or PAL inputs for display on any existing VGA/SVGA computer monitor. Small compact size, 4-1/2" x 2-1/2" x 3/4". Over 600 lines of resolution, twice that of standard TV monitor! High quality audio output feeds speakers directly. Excellent grey-scale conversion; works well with B/W inputs. Power supply included; \$69 each. Dealers welcome. MATCO, Inc., 1-800-719-9605; Fax 847-619-0852; E-Mail: sales@mat-co.com Website: www.mat-co.com



B/W 430 LINE CCD CAMERA with optional black low-profile swivel adjustable enclosure. Pin hole or Std. lens type. 6, 8, and 12mm lens are available. 1/3" CCD, 3.6mm/F2.0 lens included; 9-14 VDC, 0.08 lux, IR sensitive; 1.27" x 1.27" x 0.5"D pinhole or 1" deep standard. Price @ 10 pcs., \$44 each. Enclosure: \$8; optional lens: \$18. Dealers welcome. MATCO, Inc. 1-800-719-9605. Fax 847-619-0852. E-Mail: sales@mat-co.com Website: www.mat-



SPECIAL! IC 113: PIR motion detector with audio! W/ NO/NC alarm output. CCD camera with audio can be turned on by detector. 5-1/4" (L) x 2-3/4" (W) x 2" (D). \$89 @ 5 pcs., \$82 @ 10 pcs. Matco, Inc. 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com



AS-1004, FCC approved. 2.4GHz transmitter & receiver with audio! Capable handling total of 4 wireless cameras, range: >300'. Built-in camera, 400 TV line. \$189 a pair @ 5 pcs., \$179 @ 10 pcs. Additional camera \$119 @ 10 pcs. Matco, Inc. 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com

SEEKING DISTRIBUTORS FOR SECU-RITY Matco, PRODUCTS. 630-350-0299. Schaumburg, IL www.mat-co.com

WIRELESS VIDEO audio Wavecom Jr., \$95; Wavecom Sr., \$140; Baby monitor, \$180. Tel 1-800-600-4974, www.aljon tech.com



13406 Saticoy Street North Hollywood, CA 91605 800-235-6222 818-787-3334·F-818-787-4732

HTTP://WWW.Davilyn.com/Electronics





### JONES MODEL 1600-1 **TACHOMETER**

Instrument tachometer cen-trifugal mechanical tach mea-sures RPM scale 0-500 RPM,

coupling shaft 1/8" accessories, various size rubber tipped drive couplings, case new. Als Jones Model 1600-7 RPM scale 0-11,000 RPM w/accessories.

New \$35/ea, or 2 for \$50

### SEXTANT

Aircraft or marine navigation. No case. AS-IS \$50

SINGER CSM-1 COMMUNICATIONS SERVICE MONITOR



RF signal source: 0 to 600MHz in 100MHz 600MHz in 100MHz
steps plus 100Hz
vernier. RF output: 110
to 0 dBm, built-in oscilloscope monitor. Inputs:
RF, detected, vertical,
horizontal, AM/FM.
Outputs: audio, tone, RF.
Says
Says
Says

### TELEGRAPH KEYER

Unique item for military collectors. J37 telegraph key, new in original government package.



\$49.95



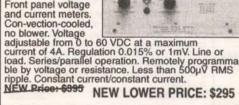
# AN/URM-120 50 OHM THRU-LINE RF WATTMETER

Frequency range: 2MHz to 1000MHz. Power range: 10 watts to 1000 watts. USWR≤1.08 to 1.

Uses three plug-in coupler elements (included). CU-753 2 to 30MHz 50 to 100 watts CU-754 25 to 250MHz 10 to 500 watts CU-755 200 to 1000MHz 10 to 500 watts. Connector: Type N. Case included. Size: 7"Wx6-5/8"H x7-1/5"D. Weight: 6.5 lbs. Price: \$395

# LAMBDA LK344A-FM POWER SUPPLY

Front panel voltage



### **HP 8640B SIGNAL GENERATOR OPT 003**



### CONDITION CODE "A"

Frequency: 500KHz to 512MHz. Indicates to 1024MHz. Requires external frequency doubler for 1024MHz (supplied with unit). Readout can be used as a frequency counter. Accuracy: 6.5 digits expandable to X10 and X100. Output: -145dBm to +19dBm (0.5 to 512MHz). Modulation: AM, FM, pulse, 400 and KHz, ImV to 1V internal. Has input and output of modulation sources.

BEST BUY

\$1.095 \$775

Write in 46 on Reader Service Card.

### SATELLITE **EQUIPMENT**



FREE BIG dish catalog. Low prices! Systems, upgrades, parts, and "4DTV." Skyvision, 1010 Frontier Dr., Fergus Falls, MN 565370. www.skyvision.com Call 1-800-543-3025.

SATELLITE EQUIPMENT available: Receivers \$25 and up; 20-25 LNB \$30; C-KU feed horns \$65. Call 757-599-4408.

BEST PRICING on 18" satellite TV systems for home and RV. DSS, DISH Network programming, multi-room viewing options, accessories. www.sky vision.com Call 1-800-543-3025.

SATELLITE RADIO BOOK AND GUIDE. New book covers all Audio Services, SCPC, Subcarriers, FM Squared, Facsimile, Press Services, Weather Services. Simple how-toreceive instructions. \$16.95 plus \$3 Priority Mail. UNIVERSAL ELECTRON-ICS, 4555 GROVES ROAD, #12, COLUMBUS, OH 43232. 614-866-4605.

FREE FLYER on DBS files, hacking, hardware info. Smart card socket \$5 ea. New Atmel 89C52 \$10 ea. Bill 1-800-879-9657

### MILITARY SURPLUS **ELECTRONICS**

### **AUDIO – VIDEO** LASERS

FREE LASER CATALOG. Helium-Neon, Argon, ruby, visible laser diode modules, lightshows, holography, laser pointers Lowest prices. Midwest Laser Products, PO Box 262, Frankfort, IL 60423. 815-464-0085 www.midwest-laser.com

# Gibraltar Trade Center COMPUTER & TECHNOLOGY SHOWS



- TREMENDOUS ADVERTISING SUPPORT
- IMPRESSIVE CROWDS
- EASY SET UP & TEAR DOWN CONVENIENT NEARBY HOTELS

TAKE A LOOK www.gibraltartrade.com

TRADE CENTER, INC.



## MT. CLEMENS, MI

15 - 17, 1999 NOVEMBER 19-21, 1999

## TAYLOR, MI

**OCTOBER** 29 - 31, 1999 NOVEMBER 26 - 28, 1999 **DECEMBER 17-19, 1999** 

## MT. CLEMENS. MI

I-94 & N. RIVER RD. (EXIT 237) · 810-465-6440

### TAYLOR. MI

I-75 & EUREKA RD. (EXIT 36) • 734-287-2000

2176 E. Colorado Blvd. • Pasadena, CA 91107

## **TOLL FREE:** 1-800-325-9465

FREE 148 PAGE CATALOG!

C & H SALES COMPANY HAS BEEN IN BUSINESS FOR OVER FIFTY YEARS. WE'RE THE BEST SOURCE FOR GREAT BUYS ON ITEMS LIKE THESE - AND MORE!

**ELECTRONIC COUNTER** HEWLETT PACKARD, Model 5328A. Universal counter. Usable to 100

MHz, 100 ns single shot resolu-MHz, 100 ns single shot resolution. Has frequency, period, period average, ratio, totalize, scale functions. A built-in digital voltmeter allows measurements of input voltages. Two input channels provide individual slope, polarity and level settings. Has 9 digit LED readout. Input power 100–240 VAC 48–66 Hz 100 VA max. Dimensions: 17" wide x 17-1/4" deep x 21/2" but the settings. 3-1/2" high.

Stock #TE9808

\$250.00



SOLA CONSTANT VOLTAGE TRANSFORMER

SOLA ELECTRIC, #93-13-150. Harmonically neutralized constant voltage transformer. Rated at 500 watts. Input constant voltage transformer, Hated at 500 watts, input voltage 95 to 130 VAC 60 Hz. Output voltage 120 VAC. This unit is designed for rack or bench mounting. The meters on the front panel indicate output current and input/output voltage. A toggle switch is provided for selection of input or output voltage. The input voltage is connected at the rear of the unit via a covered electrical panel. Two standard 3-wire grounded electrical outputs are supplied on the front and rear panels. Dimensions: 19" wide x 14-1/4" high x 10-1/4" deep. Weight 59 lbs. Stock #STR9900 \$225.00

MILLIOHMETER HEWLETT PACKARD, Model 4328A. Designed to measure

very low resistances Measurement range 1m ohm to 100 ohms.
Resolution 20 u ohms.
Analog meter readout. Ideal for

Analog meter readout. Ideal for measuring contact resistance of switches or relays. This unit is also useful for measuring the resistivity of semi-conductor devices. (Requires special 4 terminal probes which are not supplied, but probably are available from Hewlett Packard.) Power input: 115–230 VAC 48–66 Hz, 5 VA max. Dimensions: 5-1/8" wide x 11-1/2" deep x 6-1/2" bloom to the supplied of the

Stock #TE9812

\$200.00

ALTIMETER/BAROMETER

KOLLSMAN, #MC-2 MS28074-2. Scale type altime-ter with barometric setting scale window. Altimeter scale range -1000 to 80,000 feet. Barometric

range 28.1 to
31.0 inch of mercury. An adjustment knob is provided for solution of mercury. An adjustment knob is provided for scale setting to local altitude or barometric pressure. Has white numerals on a black background. Illumination is provided. Electrical input is rated 115 VAC 400 cycles. Pressure input port is female 7/16"X20 thread. Standard aircraft panel 3-1/8" mount. Dimensions: 2-17/64" sq. x 7-1/2" deep.

Stock #STOCK #IN9900

☑ Master Charge

☑ Visa

☑ American Express

☑ Discover

Call us first if you have surplus inventories of electronic, optical, or mechanical items for disposal

Write in 48 on Reader Service Card.

WANTED: PRO video equipment, VCRs, switchers, cameras, etc. Advanced Media 702-874-1911.

ATV 2.2GHz to 2.7GHz wireless video data link module tuner & transmitter 100mW. Picotronic, web: http://mem bers.aol.com/picotronic/atv.htm

SONY PLAYSTATION MODCHIPS. Allows playing of CDR backups & inports. \$10 + \$3 shipping. 619-590-9320.



ANTIQUE VIDEO TRANSFER SER-VICE: transfer any 2" QUADRUPLEX tape. Affordable fast! Phone/fax 415-821-7500 or 415-821-3359. 5001 Diamond Heights Blvd., San Francisco, CA 94131-

LASER SHOW SYSTEMS AND COM-PONENTS. Hobby and professional projectors. www.redline-lasers.com

BROADCAST VIDEO equipment wanted: all types, new or old. Please call, Jon with info. 1-800-539-2859.

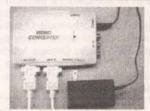


SYNC-A-LINKS's 3-D Scopers™ digital color CCD cameras for stereoscopic imagery. At a reasonable cost. Phone or Fax 918-479-6451 or write to **Sync-A-Link**, PO Box 4, Locust Grove, OK 74352.

SYNC-A-LINK UNIVERSAL video sync generators. For more details phone or fax 918-479-6451 or write to Sync-A-Link, PO Box 4, Locust Grove, OK 74352.



STEREOSCOPER VR is a stereo multiplexer that creates 3D stereoscopic video from two genlock cameras. Stereoscoper VR comes with LCS glasses and driver. 90 day warranty \$247 or write to **Sync-A-Link**, PO Box 4, Locust Grove, OK 74352. Phone or fax 918-479-



CONVERTS PC MONITOR to SECURI-TY MONITOR. The VGA-801 accepts standard NTSC or PAL inputs for display on any existing VGA/SVGA computer monitor. Small compact size, 4-1/2" x 2-1/2" x 3/4". Over 600 lines of resolution, twice that of standard TV monitor! High quality audio output feeds speakers directly. Excellent grey-scale conversion; works well with B/W inputs. Power supply included; \$69 each. Dealers welcome. MATCO, Inc., 1-800-719-9605; Fax 847-619-0852; E-Mail: sales@mat-co.com Website: www.mat-co.com

WANTED: SONY remote #RMT 135. Phone 562-941-1878.

### CABLE TV

GENUINE UNMODIFIED JERROLD DPBB 7312. 410-485-7772. E-MAIL: CLEWIS7298@AOL.COM

CABLE BOX repairs and upgrade. Most models, warranty lowest prices. Call 214-695-5982.

DTV & DISH NETWORK INFORMA-TION (33 pages) only \$15. Call toll-free 1-877-856-0923. Plus cable television reference guides for all systems, call 1-877-880-0197.

NEW! CABLE converter electronic service equipment and supplies for most cable converter boxes. Highest service, lowest prices. Call Ken Erny Electronics. 24 hr. order and information hot line 516-389-3536.



NOTCH FILTERS 110, 108.5, 106.5, 97.5 75dB deep notch. \$19.95 ea., 1-5 qty. \$15.95 ea., 6-10 qty. \$11.95 ea., 11-20 qty. \$9.95 ea., 21 or more qty. Call 24 hr. order and information hot line 516-389-3536.

**DISCOUNT CABLE converters, bullet** snoopers, all makes and models: Genuine unmodified General Instrument, Jerrold, Tocom, Scientific Atlanta, Zenith, Pioneer, Panasonic and more. Best warranty. Free catalog 1-800-243-0962.

PLAIN CONVERTERS: Brand-new, the most reliable in the market today. V-Master 3800 only \$75 each, refurbish Panasonic-TZPC-175, \$39. Minimum 10lot, 1 full year warranty, same day shipping. 405-634-1535.

## COMPUTER PARTS

NEW ARRIVALI

Super Deal on new Pentium II PC System-Fully Y2K Compliant.

BAREBONES SYSTEM

\$245

Mainboard + ATX case, 56K V.90 Fax/Modem, 8MB AGP Video, 3D sound, 10/100 network adapter, removable hard drive kit, floppy drive, speakers, keyboard, and mouse. (CPU, memory, & hard drive not included...available below.)

Memory		Other Add-ons		
SDRAM PC-100 32MB/64 128MB/256		4.3 GB Hard Drive	\$39 \$95	
Vackard Rall Ingradoc		8.4 GB Hard Drive 10.8 GB Hard Drive	\$124 \$149	
VIDEO: 512K Kit	\$18	Processors		
1MB Kit CACHE: 128K Kit	\$49 \$18	Intel Celeron 400/500 MHZ	\$89/19	

LA PAVI ELECTRONICS INTERNATIONAL P.O. Box 261095 San Diego CA 92196 Tel. 858.586.7610 \* Fax. 858.586.1482

\$25

\$59

Order Line: 800.586.4199

CPU: Intel 486 DX2-66

Intel Pentium Overdrive

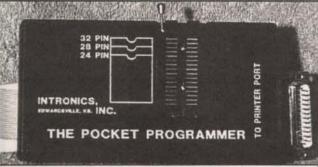
Visit Our Website @ www.lapazelectronics.com

Intel PIII 500 MHZ

Intel PII 400/450 MHZ \$209/230

\$290

The Pocket Programmer



The portable programmer that uses the printer port of your PC instead of a internal card. Easy to use software that programs E(E)prom, Flash & Dallas Ram. 27(C)/28(C)/28F/ 29F/29CXXXX & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, MCU's 874X, 875X, 40-Pin X 16 & Serial Eprom's, PLCC, 5-Gang, 82/74 Prom's and Eprom Emulator to 32K X 8.

Only \$129.95

Same Name, Address & Phone Number for 16 Years.... Now isn't that Amazing?

Intronics, Inc.

Box 13723 / 612 Newton St.

Edwardsville, KS 66113 Tel. (913) 422-2094

Add \$5.00 COD Add \$4.00 Shipping

Fax (913) 441-1623 Visa / Master Charge / Amex

ATTN. DEALERS: Are you a current dealer or just getting started? Buy factory direct & save. New 125 channel volume control converter, 800MHz tuner. Also available non-volume converters. Call for lot pricing. A & S Wholesale, 1-800-370-0801.

CABLE DESCRAMBLER plans!!! Plus two free bonuses: radar jammer plans & cable manual, \$14. 1-888-367-9972.

PICS. GALS READ if you've lost your masters. Programming service available. Call for info. Network Sales, 616-683-0500

UNMODIFIED CABLE CONVERTERS. Zenith ST1600, ST1086, ST300, Panasonic 175, 145 vol. & non-vol. Regal RR-92 & RC 83, DP5, DP7, DRZ, 5503 VIP, SA 8580. Guaranteed low prices. Please call for more converters 405-631-

CABLE TV. Unmodified converters DP5 \$35; DPBB7 \$80; 8500 series \$15, etc., good prices over 100 pcs. Minimum 10 pcs. any qty., plus all major brands available. Lowest price new/refurbished/field pulls. Phone: 1-800-929-1549.

CABLE CONVERTERS, DBS, remotes, schematics, etc., free flyer. Smart card socket \$5 ea. New Atmel 89C52 \$10 ea. Jake 419-385-3100.

CABLE PARTS! Computer parts. Call for great prices or visit us on the Web: HTTP://WWW.CB-Electronics.com or call 1-800-436-8630.

RAW CONVERTERS: We have the best quality to your cable needs. PIO-5135 \$45; Zenith ST-1600 \$75; S/A 8590 (10-\$45, 26fill 31-160 \$73, 3/A 6390 (10-8) \$65 each; \$/A 8590 (11-8) \$75 each; \$Comto 5503 VIP (450 MHz) \$35 each; \$Comto 5503-A only \$2 each. Call for others not listed. 405-631-5153.

POSITIVE NOTCH filters. Channels available: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, and 25, \$16 each. Channels 26, 27, 28, 29, 30, and 31, \$19 each. Channel 39 \$25 each. Order by single channel. Top quality non-tunable metal cylinder types. 75dB deep on notch. Need to block the video on a cable channel til the kids do their homework, order a negative notch filter from our company. We carry large stock on all channels. Visa, MasterCard, Discover and UPS COD. "The Filter Company" Quantity pricing on 5 or more. 100 pcs. \$7 each. Call 1-800-235-8080. On the web go to www.gofi Iters.com lots to see. Open 8am to 5pm Central Standard Time, Monday-Friday. All sales must comply with FCC 1996 cable act.

AUCTION AUCTION Auction. Join us online to buy and sell. www.cabletv-auctions.com We have a lot to see. Companies and individuals can put equipment up on the Internet. Cable TV equipment, computers, electronics, telephony, and anything else related. Sell surplus electronic equipment. Phones, faxes. Join us online or call for details. 1-888-451-0083. We advertise in the following publications: USA Today, Nuts & Volts, Popular Electronics, Electronics Now, Popular Science, and Popular Mechanics. Our website is taking 10,000 hits per month. Call to advertise your company. We also advertise in small newspapers in the USA and Canada. You now have pure exposure to the world. Let us help you sell your equipment.

CABLE CONVERTERS. Original equipment with remote. Like new, ready to go. Lowest prices guaranteed. Limited models. Novicor Electronics, 412-833-0773.

SONY PLAYSTATION MODCHIPS. Allows playing of CDR backups & imports. \$10 + \$3 shipping. 619-590-9320

## **TELEPHONE LISTENING DEVICE WITH** 12 HR. RECORDER



Record telephone conversations in your office or home. Starts automatically when phone is answered, records both sides of phone conversation. Recorder stops when phone is hung up. \$99.95 + \$7 shipping. For telehone listening device separately \$19.95 + \$2 ship.

For comprehensive 50 page catalog of Micro Video, VHF transmitters, Surveillance, and Counter-surveillance and much more! Send \$3.00

Call 407-725-1000

## **USI CORP**

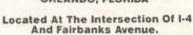
P.O. Box N2052 Melbourne, FL 32902 COD'S OK

Write in 50 on Reader Service Card.

When Visiting Disney World And Sea World. Come To The World Of Electronic Surplus!

## SKYCRAFT

PARTS & SURPLUS, INC. ORLANDO, FLORIDA



Self-Service Retail Outlet Featuring Commercial And Government Electronic Surplus Including:

- WIRE SWITCHES
- RESISTORS TRANSISTORS
- TRANSFORMERS TEST EQUIPMENT
- COAX
- HARDWARE
- CAPACITORS
  PANEL METERS
  CIRCUIT BOARDS
  INTEGRATED CIRCUITS

\*\*\*\*\* We Buy Surplus

Electronic Parts -FAX your list. www.skycraftsurplus.com

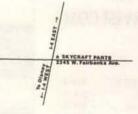
FAX 407/647-4831 PH 407/628-5634

P.O. BOX 536186

ORLANDO, FLA. 32853-6186

### HOURS:

Monday - Friday 8:30-6:00 Saturday 8:30-5:00



### **FOR THE BEST** PRICES ON PROFESSIONAL TOOLS, **CALL ELECTRO-TOOL**



Platt - Case - Deluxe Polypropylene. Chemical Resistant. Tools by CooperTools and others. 800T Case, complete with tools ... \$419.95 800T Case Only . . . \$121.80



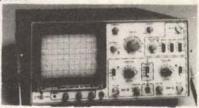
Platt - Case - Cordura Exterior. Two exterior pockets & one literature pocket. 660ZT Case, complete with tools ... \$223.00 660ZT Case Only ... \$59.45 Optional Sperry meter #DM6510 as shown . . . \$65.00



Weller WCC100- Electronically controlled station, temperature adjustable from 350°F-850°F, Zero voltage circuit-safe for sensitive components, 40 Watt pencil . . . \$97.90



OptiVISOR magnification, Optical Glass Prismatic lenses (not plastic). Select any one of (6) magnifica-tions . . . \$24.00

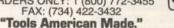


GoldStar - 20 MHz Dual Trace Oscilloscope OS-9020A-Large 6" rectangular, high sensitivity: 1mV/div, high accuracy: ±3%, stable, low-drift design, 8 divisions of displayed dynamic range and accurate, distortion-free waveform measurements . . . \$372.00

### Electro Tool, Inc.



9103 Gillman, Livonia, MI 48150 Customer Service: (734) 422-1221 ORDERS ONLY: 1 (800) 772-3455 FAX: (734) 422-3432





CABLE PARTS & EVERYTHING. Best prices & quantity discounts. WE DON'T SELL BOXES. 1-800-MODULE-0.

CALL US TOLL FREE FOR ALL YOUR CABLE NEEDS. OFFICE HOURS: M-F 9AM-5PM EST. COD ONLY, FREE SHIPPING ON FIRST ORDER. TOLL FREE 1-877-282-7641.

PC BOARD ASSEMBLY. Thru hole only. Small or large quantities OK. Call Network Sales. 616-683-0500.

ZENITH TUNER bump-up boards, make 24 pin 70 channel to 84 or 40 pin 78 channel into 84 channel, \$19 ea. 519-252-2512

ZENITH CHANNEL 3 mod's for 1000-1086 for sale, \$1.50 ea. 519-252-2512.

### TELEPHONE/FAX

12 HOUR fully automatic heavy duty professional TELEPHONE RECORDER, \$79 including shipping. Send check or money order to: VAKIS, 1402 Pine Ave., Niagara Falls, NY 14301.

CELLULAR PHONES & equipment. 1-800-735-6944, 24 hrs., include area

PHONE SYSTEMS WANTED!!! We buy AT&T MERLIN, SYSTEM 25/75/85 and other AT&T phone systems. Please call for a quote or fax us your equipment list. KEYWAYS, INC., 937-847-2300 or FAX 937-847-2350.

FOR SALE: GTI phones, send for specifications. Toshiba, Strata DK 424 and Z80 DK 14 and 40, computer telephony integration, wireless telephone system, Aries digital GTI key system, ADKS 144, send for specifications. Applications made to order, desktop #2500 \$360 ea. prepaid. Small business guestrooms. Ohio Service Supply Co., PO Box 8802, Canton, OH 44711.

FOR SALE: All items new in MFG box. Toshiba, computer, telephony-system, PC Strata, DK 424, Iwatsu-build Adix, vs to suit your needs. Cortel Co., Aries, digital, key-system, ADKS 144, ACB cards for many applications. Send for mfg. items list. Ohio Service Supply Co., PO Box 8802, Canton, OH 44711.

MFG. COMPUTER telephony integra-tion. We have stratagy DK Aries, key system ADKS 144. Send for full detail and mfg. items list. 3U hot swap, backplane assemblies. 6U computer telephony assembly. Ohio Service Supply Co., PO Box 8802, Canton, OH 44711-8802.

PBX PARTS model SR224/SR96 new boards, cabinet/motherboard, manuals, monitor, request list 405-247-3480 or gene@tanet.net

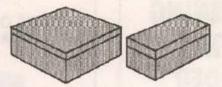
### COMPONENTS

RF TRANSISTORS, TUBES, SD1446, MRF455, MRF454, 2SC2290, 2SC1969, 2SC2166, 2SB754, TA7222AP. 2SC1947, TIP42C, KIA7217, MRF422, MRF448, MRF247, MRF317, SAV7, SAV17, 3-500ZG, 4CX250B, 572B, SAV17, 3-500ZG 3CX400A7/8874, 3CX3000A7 4CX400A, silver mica caps, resistors, electrolytics, etc. Westgate 1-800-213-4563.

CASH PAID FOR ICs. Military or commercial integrated circuits, transistors, diodes, any semiconductors. ELECTRONIC SURPLUS, INC., 5363
Broadway, Cleveland, OH 44127. 216-441-8500 or fax 216-441-8503, since 1946, www.electronicsurplus.com



AMAZING! 35¢ ALL TOGGLE SWITCH-Brand new. Rated 6A/125V. Hardware included. 1/4" panel hole. SPDT or DPDT on-on, or on-off-on. Minimum 100pcs./package. Add \$6 freight. Gateway Products Corporation, PO Box 936397, Margate, FL 33093, 954-227-9300. VISA/MC, no COD.



POCKET MINI-BOXES: Small plastic boxes. High quality, LOW COST! Low as \$0.49. Attention manufacturers! Great for products! 805-339-0702.

www.ElectronicsUSA.com

SEE OUR ad on 4-channel 2.4GHz wireless system in the AdMart section on page 84, Matco, Inc.

WANT TO Buy: ICs, military & aircraft relays, diodes, transistors, Cannon, TRW, Amp, Burndy, Deutsch, Bendix connectors, electronic test equipment & most components. Hoffy Electronic Ent., 818-718-1165, FAX 818-341-5506. E-Mail: Hoffie1165@aol.com



B/W 430 LINE CCD CAMERA with optional black low-profile swivel adjustable enclosure. Pin hole or Std. lens type. 6, 8, and 12mm lens are available. 1/3" CCD, 3.6mm/F2.0 lens included; 9-14 VDC, 0.08 lux, IR sensitive; 1.27" x 1.27" x 0.5"D pinhole or 1" deep standard. Price @ 10 pcs., \$44 each. Enclosure: \$8; optional lens: \$18. Dealers welcome. MATCO, Inc. 1-800-719-9605. Fax 847-619-0852. E-Mail: sales@mat-co.com Website: www.mat-

**DIAMOND-TIPPED BURS** for Dremeltype tools. Set of 20, in case, \$8 postpaid (check, MO). John Hill, 5734 Vickie Dr., Winston-Salem, NC 27106. Visit Honest John's Electronic Barn on the web! http://soar.to/honestjohn

NEW SURPLUS ICs: (250) AY-3-1015D @ \$5; (275) CD10105BE @ \$0.35; (104) ICM7217IIJI @ \$4.75; (65) MM54104N @ \$9; (325) MM74C901N @ \$0.35. Doppler Systems, 480-488-9755 or dave@dopsv.com

### MICROCONTROLLERS

WIN \$500 USD cash dontronics.com

### **ANTIQUE ELECTRONICS**

WESTERN ELECTRIC wanted: 1920s-1960s. Amplifiers, mixers, pre-amps, speakers, tubes, etc. FREE OFFER 1-800-251-5454.

WANTED: FOR historical museum, pre-1980 microcomputers, magazines, and sales literature. Floyd, VA 24091-0341 (540-763-3311/540-382-2935).

CRYSTAL SETS. Parts, plans, books, kits. Largest source in the world. Catalog \$2. B. TURKE, PO Box 222288, Hollywood, FL 33022.

RADIO TUBES and phono. needles. 870-347-2281.

### AVIATION ELECTRONICS

BUY, SELL, trade, avionics equipment, Collins, King, Sperry: test equipment, IFR, Litton LTN series INUs. 941-625-3222 P, 941-625-0494 F, E-Mail: avio nics@afcon.net

### **PUBLICATIONS**

WEBBOOKS OFFERS discount prices on technical/engineering books plus free assistance to authors. Please visit us at http://webbooks.net

NEW SURVIVAL COMMUNICATIONS BOOK. How to build complete home communications systems. Covers all needs: shortwave radio, amateur radio, citizens band, scanners, federal, weather, alternate news, satellite radio, equipment sources. How to build and use alternate emergency power sources, solar, generators, backup batteries. 200 pages. \$24 Fast delivery Priority Mail. MC or Visa. Call Universal Electronics 1-800-241-8171

TORMET'S ELECTRONICS BENCH REFERENCE is now at REV03. More laser, op-amp and Tesla coil circuits. New optics and statistics pages. Check the web site at www.ohio.net/~rtormet/index.htm or send \$19.95 + \$2.50 postage to RMT Engineering, 6863 Buffham, Seville, OH 44273.

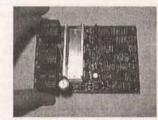
### **ROBOTICS**

ROBOT BOOKS.COM visit our web site for reviews of robotics books, plus robot kits, toys, movies, and magazines! www.robotbooks.com

ARobot KIT from Arrick Robotics uses the BASIC Stamp II. Quality metal construction. Easy to assemble and very expandable. \$235. http://www.robot ics.com/arobot

www.futurerobots.com ROBOTICS for active security systems is now possible for the amateur electronic experimenter to design and build. Come and see the future of home robotics and read Lab Note 116 Design Concepts for Various Types of Guard Robots, Also other technical articles about active security robot and systems.

ROBOTS WANTED: Dead or alive, whole or parts. Marvin (Iowa Precision), Gemini, RoPet, Hubot, RB5X, Newton SynPet, ComroTot, ELAMI, ITSABOX, HeathKit (HERO JR, 1, 2000, or Arm Trainer), Androbots (TOPO, BOB, Fred, and Androman), Rhino, Maxx Steele, Omnibots, etc. Also looking for robot proteins and interest and interes totypes, options, and literature, will pay cash. Please E-Mail rdoerr@bizserve.com Call 810-777-1313 or write to: Robert Doerr, 26308 Cubberness, St. Clair Shores, MI 48081.



H-BRIDGE MOTOR controllers. 12V (\$25) and 24V (\$35) versions. 35A average, 50A peak PWM out. Many features. Compact. Approximately 3.75" by 5.5". 570-735-5053. http://members.tripo. d.com/~divelec

### ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401 (612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM WE BUY TEST EQUIPMENT AND COMPONENTS. VISIT US ON THE WEB AT WWW.ABCTEST.COM

VISIT US ON THE WEB AT	WW	W.
HP 54501A 100MHZ DIGITIZING SCOPE	\$1300.00	H
HP 54201D 300MHZ DIGITIZING SCOPE	\$1000.00	H
HP 54201A 300MHZ DIGITIZING SCOPE	\$1000.00	Н
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	\$700,00	E
HP 3312A 13MHZ FUNCTION GENERATOR	\$250.00	F
HP 5370A 100MHZ U.T.I. COUNTER	\$400.00	L
HP 3586C LEVEL METER	\$750.00	T
HP 436A POWER METER W/O SENSOR&CABLE	\$500.00	T
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2000.00	T
HP 3437A 3 5DIGIT SYSTEM VOLT METER	\$250.00	T
HP 3455A DIGITAL MULTIMETER	\$250 00	T
HP 3456A DIGITAL MULTIMETER	\$400.00	T
HP 3336C SYNTHESIZER/LEVEL GENERATOR	\$800.00	T
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1000.00	T
HP 5335A 200MHZ COUNTER	\$600.00	T
HP 8165A PROGRAMMABLE SIGNAL SOURCE	\$1100.00	T
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	\$1000.00	T
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	\$3000.00	T
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00	T
HP 6034A 60VDC-10A POWER SUPPLY	\$750.00	T
HP 6269B 40VDC-50A POWER SUPPLY	\$800.00	T
HP 6553A 40VDC-12 5A. POWER SUPPLY OPT.JOI	\$1200.00	N
HP 6632A 20VDC-5A POWER SUPPLY	\$500.00	V
HP 6643A 45VDC-4.3A POWER SUPPLY OPT JO3	\$750.00	W
Lancas and the same and the sam		

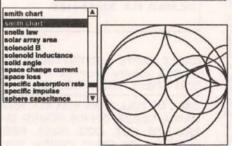
IP 4935A TRANS IMPAIRMENT TEST SET \$900.00 IP 5006A SIGNITURE ANALYZER \$150.00 HP 86602B IMHZ-1300MHZ RF PLUG \$400.00 \$1500.00 EIP 575 MICROWAVE COUNTER \$550.00 LUKE 95 50MHZ SCOPEMETER ECROY 7200 400MHZ O-SCOPE \$1000.00 TEK 475 200MHZ O-SCOPE \$500.00 TEK 465 100MHZ O-SCOPE \$400.00 TEK 496P IKHZ-1.8GHZ SPEC.ANALYZER \$3500.00 \$750.00 TEK 1240 LOGIC ANALYZER TEK TDS320 100MHZ DIGITAL O-SCOPE \$1400.00 TEK 11401A 500MHZ PROG.0-SCOPE FRAME \$750.00 TEK 7854 400MHZ OSCILLOSCOPE FRAME \$500.00 TEK 7904 400MHZ OSCILLOSCOPE FRAME \$250.00 TEK 7A26 200MHZ VERTICAL PLUG \$75.00 TEK 7A24 400MHZ VERTICAL PLUG \$150.00 TEK 7B80 400MHZ TIME BASE \$75.00 TEK 7B92A 500MHZ DUAL TIME BASE \$125.00 TEK 7S12 SAMPLING PLUG \$250.00 TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER \$1000.00 TEK AMSOS CURRENT PROBE AMPLIFER \$250.00 WAVETEK 145 20MHZ PULSE/FUNCTION GEN. \$400.00 WAVETEK 182A 4MHZ FUNCTION GEN WAVETEK 955 7.5-12.4GHZ MICROSOURCE \$1100.00

## A DEGREE ON A DISK!

Electro Science Applications Inc.

**EM FORMULARY** 

File Formulas Conve



- · 500+ formulas and simulations
- · Unit conversions and data tables
- Physical constants
- Electronics, communications, radar
- · Antennas, filters, optics
- · Physics, math, space science
- · Practical and educational

Self-contained and intuitive, you'll be up and running in minutes. Fast menu and hyperlinked access to equations and data. Current version 1.7 works with Windows 3.1, 95, or 98.

ELECTRO SCIENCE APPLICATIONS, INC. P.O. BOX 11158, TORRANCE, CA 90510

To order, call (310) 539-2422 or E-Mail esa@earthlink.net Send \$29.95 check or money order (CA residents add 8.25% sales tax).
Foreign orders add appropriate shipping charge.

Electronic and RF design services also available. Visit us at http://www.esap.com

S.A.M. ROBOT kit. Build this great looking small robot with your servos, microcontroller, and sensors. Or buy every-thing from us. We now offer the BASIC Stamp, Visit http://www.smallrobot.com

### PLANS - KITS -**SCHEMATICS**

BUILD THE MENDOCINO MOTOR. This fascinating device is a solar powered, magnetically levitated motor. It will delight and amaze you and your friends. The 27 page plans book includes a list of parts suppliers. The motor uses readily available parts. Plans are \$15 plus \$2.50 S&H. Write to: St. Elmo's Fire, PO Box 141, Stow, MA 01775. E-Mail: tcv@gen rad.com

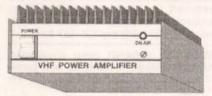


CIRCUIT BOARDS. Low-cost, precisionmade PC boards from your CAD program files (no photoplots required). Single and double-sided with contour routing. Ideal for RF/analog/digital prototypes. Full details at http://www.pc E-Mail: bmilling.com feed back@pcbmilling.com FAX: 703-818-



TERRIFIC TIMEPIECES! LED binary clock. LED digital clocks, other kits! Free catalogi WPC 805-339-0702. www.ElectronicsUSA.com

MAKE YOUR OWN PHOTOVOLTAIC CELLS! Incredibly easy, cheap, com-pact, and versatile. Complete instructions. wclark@infoave.net



**BROADCAST FARTHER!** 75-110MHz amplifier connects to stereo transmitters. Produces 2-15 watts. Requires 50-150mW drive. Complete plans with part source and antenna information only \$14 + \$2 S&H. Progressive Concepts, PO Box 586, Streamwood, IL 60107. 630-736-9822

PIC INSTRUMENTATION and monitor chips, kits, quick-build protoboards, telephone electronics, pocket testbench. Oricom Technologies, 303-449-6428. www.sni.net/~oricom



WWW.THERMA-DYNE.COM CON-TAINS full details of our new 2 channel module. It records & time stamps ON, OFF events into PC. Photocell coupled. Many uses: logging & counting, surveillance, time & motion studies, appliance monitoring, process timing. Simple adaptable QBasic program & tutorial included. \$38. THERMADYNE, INC.

CONSUMERTRONICS 120+ exciting manuals: Electronics, computers, Internet. phones, energy, radionics, financial (including stocks), crime-fighting, security, survival, phenomena, SPE-CIAL PROJECTS. Catalog \$3. PO Box 23097, Albuquerque, NM 87192. www.tsc-global.com

### MANUALS - SCHEMAT-**ICS WANTED**

### **MISCELLANEOUS** ELECTRONICS FOR SALE



SOLAR-POWERED FAN HAT. Baseball type hat with solar powered fan. Great for sports fans, golfers, etc. Available in red or blue. \$19 plus \$2.00 shipping. CA residents add 7.75% sales tax. Visa/MC/Disc/Amex OK. H.T. Orr Computer Supplies, 249 Juanita Way, Placentia, CA 92670. 714-528-9822, 1-800-377-2023, FAX 714-993-6216.

SOLAR ELECTRIC SUPPLIES: All manner of solar electricity available here. 64 watt panel, \$319. 120 watt panel, \$589. Flexible 5 watt, \$89. Controllers start at \$39.95. Inverters, shunts, racks, mounts, etc., solar roofing shingles. Visit www.planetarypower.com 1-877-SOI AR-PV

NUCLEAR ELECTRONICS (NIM. CAMAC), PMTs, optics, high vacuum, and high voltage components and equipment. Guaranteed quality at reasonable cost. OE Technologies, Box 703, La Madera, NM 87539. Ph: 505-583-2482, Fax: 505-583-9190, E-Mail: oetech@ newmexico.com http://www.oetech.com

### **REFILL INKS FOR INKJET PRINTERS**

Refill your old cartridge and save. All refill kits come with instructions and needed materials for refilling inkjet cartridges. Success guaranteed. Available for the following:

CANON BC-01, BC-02 CANON BJ10e, APPLE STYLEWRITER, BJ-200 Single, Black, \$8.00. CANON BJC-600 (BC-201) Single Black or Single Colors (3 refills) \$8.00. CANON BJ-130/300/330 & IBM Exec Jet (Cart #BJI-481 & BJI-642) Black - 3-bottle kit \$22.00. CANON BJC-210/240 (BC-05 Cart) 3-color kit (3 refills each color for BC-05) \$24.00. CANON BJC-4000 and Apple Stylewriter 2400 Black 3-bottle kit (3 refills BC-20, 9 refills BCI-21 black,

30 refills BCI-11 black, 10 refills BCI-10) \$19.00. CANON BJC-4000/BJC70 and Apple Stylewriter 2400 Tri-color kit - 6 refills each color for BCI-21 or 15 refills each color for BCI-11 \$24.00. CANON BJC-800/820/880 3-bottle kit (for BJI-643B) \$19.00. CANON BJC-800/820/880 3-bottle tri-color kit (Cart #BJI-643CMY) \$24.00. EPSON STYLUS COLOR PRINTER - (Cart S020034) Single Triple black \$19.00; Tri-color kit (Cart S020036) 2 refills each color \$24.00. EPSON STYLUS COLOR II - (S020047) Triple Black \$19.00 (S020049). Tri-color (2 refills each color) \$24.00. EPSON STYLUS COLOR 400, 500, & 600 (S020093) Triple black (7 refills total) \$19.00. EPSON STYLUS COLOR 200, 500 (S020097) Tri-color 3 refills each color \$24.00. EPSON STYLUS COLOR 400, 600, 800, 1520 Tri-color (\$020089) 3 refills each color \$24.00. EPSON STYLUS COLOR 400, 600, 800, 1520 Tri-color (\$020089) 3 refills each color \$24.00. EPSON STYLUS 800/1000 (\$020025) 3-refill kit, black, \$19.00. EPSON STYLUS COLOR 440 AND 640 Black refill kit. (S020187) 4 refills plus free vacuum bottle \$19.00. EPSON STYLUS COLOR 440, 640, AND 740 (S020191) Color refill kit. 4 refills of each color \$24.00. HP DESKJET 500/550/560 (51608A, 51633A, 51626A) Black single refills \$8.00. HP DESKJET 500/550/560. Black 3-bottle kit \$19.00. HP DESKJET 500C/550C/560C. Tri-color kit (5 refills each color) \$24.00. HP DESKJET 1200C, DESIGNJET 650 (Cart #HP 51640B) Black Three pack (3 refills) \$19.00. HP DESKJET 1200C/1600C, DESIGNJET 650 (Cart #HP 51640 C,M,Y), Tri-color kit (one refill each color) \$24.00. HP DESKJET 1200C/1600C, DESIGNJET 650 (Cart #HP 51640 C,M,Y), Tri-color kit (one refill each color) \$24.00. HP DESKJET 600/660 (HP 51629A) Black three pack \$19.00. HP DESKJET 600C/660C. (HP 51649A) Tri-color (5 refills each color) \$24.00. HP DESKJET 855C/1600C (HP 51645A) Black three pack \$19.00. HP DESKJET 855C (HP 51641A) Tri-color kit (2 refills each color) \$24.00. HP PAINTJET and PAINTJET XL (51606A) Black 3-bottle kit \$19.00. HP PAINTJET and PAINTJET XL (51606C) Tri-color kit \$24.00. HP PAINTJET XL300 (C1645A & C1656A) Black 3-refill kit \$19.00. HP PAINTJET XL300 Tri-color kit (1 refill each color) HP 51639C,M,Y \$24.00. HP THINKJET, QUIETJET, KODAK DICONIX 150 (51604A or 92261A) black 5 refills \$9.00. IBM/Lexmark/Execjet/4076 (1380620) black 3-refill kit \$19.00. IBM/Lexmark ExecJet IIC, WinWriter 150 C (Cart #1380619) 4 refills each color \$24.00. Lexmark **3200**, **5000**, **5700**, **7000**, **7200**, **Optra 45** and **Z51** (12A1970) 3 refills Black \$19.00. Lexmark **3200**, **6000**, **5700**, **7000**, **Optra 45** and **Z51** (12A1980) 4 refills each color \$24.00. SNAP AND FILL SYSTEM - Permits refilling HP 51626A (black for HP 500-series) and HP 51629A (black for HP 600-series) cartridges without making a hole in the cartridge. Consists of special cartridge holder, syringe, plastic tubing, and directions. STARTER KIT - with ink for 3 refills \$28.00. EXTRA INK FOR SNAP & FILL SYSTEM (black only) 4-oz. bottle \$18.00; 8-oz. bottle \$34.00. Specify whether for HP 51626A or HP 51629A

### HARD-TO-GET PRINTER RIBBONS



Gorilla Banana, Commodore 1525 \$8.00; Adam Coleco \$12.00; TI-850/855 \$6.00; Centronics 700 Zip Pack \$5.00; C. Itoh Prowriter Jr., Riteman C+/F+ \$6.00; Riteman Inforumner \$8.00; Commodore MPS-801 \$5.00; MPS 803 \$5.00; Decwriter LA30/36 \$4.00; Apple Scribe \$4.00; Mannisman Tally Spirit 80, Commodore 1526 \$5.00; Epson JX-80 4-Color \$14.00. Printronix P-1013 \$11.00; Star SJ144 color 3-pack \$29.00. ALSO HEAT & TRANSFER RIBBONS AND PAPER FOR PRINTING T-SHIRTS

Over 300 different ribbons in stock. All ribbons new, not re-inked. Fully guaranteed. Order directly or send SASE for complete list.

Add \$4 per order shipping. CA residents add 7.75% sales tax. On ribbon orders over \$50 deduct 10% dis

### H.T. ORR Computer Supplies 249 Juanita Way, Placentia, CA 92870-2216

714-528-9822 · 800-377-2023 · FAX 714-993-6216

http://www.extremeplay.com/occomp/orr.htm



Write in 53 on Reader Service Card.

# Are you interested in Microprocessors & Embedded

Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language,

then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Examples Include:
- Making a Waveform Generator Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF Interfacing and Controlling Stepper Motors

- Scanning Keypads and Writing to LCD/LED Displays
  Bus Interfacing an 8255 PPI
  Using the Primer as an EPROM Programmer
  DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trait can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

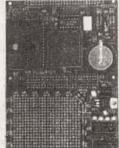


1985 - 1998 12 YEARS OF SERVICE

# MORE POWER!

68HC11, 80C51 & 80C166

AM Research supports over 30 of the most popular Embedded controllers with both hardware and software.



- ☑ More Microcontrollers ☑ Faster Hardware.
- ☑ Faster Software.
- ☑ More Productive.
- ☑ More Tools & Utilities.
- ☑ IIC Peripherials.
- ☑ Single Chip Capable.
- ☑ Outstanding Support. ☑ Custom designs.

Call or email for a free full line brochure



Orders (800) 949-8051 Info (916) 652-7472 fax (916) 652-6642 www.amresearch.com

AM Research, Inc. PO Box 43

The Embedded Controller Experts

Loomis, CA 95650

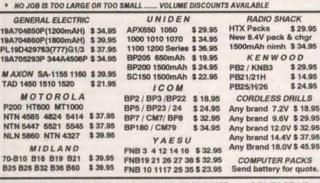
IF YOU NEED NEW BATTERIES FOR YOUR ELECTRONIC EQUIPMENT DON'T PITCH EM' - SEND THEM FOR REBUILDING! - SAVE \$\$

CUNARD ASSOC. INC., 9343 US RT 220, Bedford, PA 15522

- WE INSTALL NEW NI-CAD OR NI-MH BATTERIES INTO YOUR ORIGINAL CASE.
  WE IMPROVE CAPACITY TO BETTER THAN ORIGINAL.
  WE FIX WHAT CAN'T BE FOUND. (OR AFFORDED)
  WE PROVIDE QUICK SERVICE. / EXTENDED LIFE FOR OLDER EQUIPMENT
  WE OFFER FREE QUOTES. / FREE RETURN IF QUOTE IS REFUSED.
  WE PROPERLY DISPOSE OF YOUR OLD CELLS BY RECYCLING.
  WE GIVE YOU A 12 MONTH WARRANTY.
  WE WIN I BE REPER WHEN YOU MEET NIS / EST 1986.

- WE WILL BE HERE WHEN YOU NEED US / EST. 1986 WE SAVE YOU ..... M O N E Y .... \$\$\$\$

NO JOB IS TOO LARGE OR TOO SMALL ...... VOLUME DISCOUNTS AVAILABLE



FOR INFORMATION ABOUT YOUR REQUIREMENTS ...... CONTACT US: PHONE OR FAX: (814) 623-7000 E-MAIL TO: PRIMECELL @ AOL.COM SEND YOUR PACKS FOR FREE QUOTATION VIA UPS, RPS OR US MAIL VISIT OUR WEB SITE http://members.aol.com/primecell/primecell.htm

### BATTERY REBUILD SERVICE

MANY OTHERS AVAILABLE - WRITE OR CALL FREE CATALOG ADD \$ 4.50 SHIPPING & HANDLING PER ORDER

Write in 56 on Reader Service Card.

HIGH QUALITY TOOLS AND STAIN-LESS STEEL HARDWARE. European and American screwdrivers, nutdrivers, pliers, hex-keys, balldrivers, and more! Wiha, Bondhus, and Knipex. Stainless cap screws, machine screws, nuts, washers, Ubolts, and eyes. Free catalog. Robert Mink Import-Export, Box 6437V, Fair Haven, NJ 07704. Telephone or fax 732-758-8388. E-Mail: w2tv@csi.com

FREE FLYER on DBS, cable TV, phones, credit cards, schematics, health items. Bill 1-800-879-9657.

http://www.hackersheaven.com

PC CABLES: http://www.pccables.com connectors, RS232, IDC, SVHS, ribbon cable, DB9, DB15, loopback, null modem, jumpers, SCSI, screws, rails. Secure online catalog, ordering, browsing. 954-418-0817.

FOR SALE: Tubes galore. Send SASE for new list A+. Also test equipment (list). Tube sockets and extenders, Amphenol® plugs and sockets, 4 thru 12 pins, ditto Cinch-Jones ballast tubes, time delays, HV caps Teletype® repair parts. Typetronics, PO Box 8873, Ft. Lauderdale, FL 33310-8873. 954-583-1340, fax 954-583-0777, Fred Schmidt

**BECOME A** NUTS & voits DISTRIBUTOR Call 909-371-8497 Today!

Sunday 8am-2pm



ACP's 94th GIANT

Original!

Be a

...for

Seller

## CABLE TV CONVERTERS WILL NOT DECODE

The Best Prices and Service • In Business over 15 years!

Phone 218-346-6660 Fax 218-346-6664 TIMELESS PRODUCTS

> New! "TP 125 V" 128 Channel Converter with Volume

**Special Prices for** TP1550PC Call for Details

- REFURBISHED CONVERTERS ALSO AVAILABLE
- QUALITY REPAIR DEPARTMENT FOR ALL YOUR TUNER REPAIRS •

Panasonic still available! REMOTES AVAILABLE FOR MOST CABLE BOXES

DEALERS ONLY • GREAT QUANTITY PRICES • NO DECODER SALES



ANAHEIM WIRE PRODUCTS. DISTRIBUTOR OF ELECTRICAL WIRE AND CABLE since 1973. Items available from our stock: Hook up wire, Automotive primary wire, GXL, SXL, Plenum cable, Teflon wire, Multi-conductor cable, Irradiated PVC, SO-CORD, Mil-Spec wire, Building wire, Welding cable, Battery cable, Telephone wire, Shrink tubing, Cable ties, Connectors. Wire cut & strip to specs. If interested, please call 1-800-626-7540, FAX: 714-771-5043. Visa/MC/Amex. SEE US ON THE INTERNET: http://www.an aheimwire.com OR E-Mail: info@an aheimwire com

### **MISCELLANEOUS ELECTRONICS WANTED**

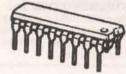
WANTED: BALANCING machines & vibration analyzing equipment manufac-tured by the following: Spectral Dynamics, Hofmann, Bentley Nevada, Schenck, IRD Mechanalysis, Gishott. Contact Mike Park at E.T. Balancing, 12823 Athens Way, Los Angeles, CA 90061. 310-538-9738, FAX: 310-538-

HIGHEST PRICES PAID: I will pay the following prices for Western Electric tubes: 211A/D/E new \$300, used \$175; 212A/D/E new \$750, used \$275; 274A/B (engraved base) new \$250, used \$200; 300B (engraved base) used \$550; 422A new \$50, used \$25; 437A new \$50, used \$25; and many more. Also buying Western Electric, and other audio tube and equipment literature. Call or send us your list. Toll free tel/fax: 1-888-715-8823. Don Singerhouse/Singerhouse Sound, LLC, PO Box 321, New Richmond, WI 54017. E-Mail: singtube@frontiernet.net

WANTED: TUBE HiFi/commercial amps, preamps, corner/horn speakers. Altec, Marantz, McIntosh, Western Electric, etc. 405-737-3312 fax 405-737-3355.

WANTED: X-BAND radar equipment. Military, civilian, working or not, parts, TMs, etc. Box 10215, Pittsburgh, PA 15232.

CASH PAID FOR ICs. Military or commercial integrated circuits, transistors, diodes, any semiconductors. **ELEC-TRONIC SURPLUS, INC.**, 5363 Broadway, Cleveland, OH 44127. 216-441-8500 or fax 216-441-8503, since 1946. www.electronicsurplus.com



WANTED: COMPONENTS, BOARD-LEVEL COM-PONENTS; MILITARY COMPONENTS; ICS, MEMORY, TRANSISTORS, DIODES, CAPS, RELAYS, ETC. CALL LA PALMA SEMICONDUCTOR, 714-523-8892 FAX 714-523-8898.

WESTERN ELECTRIC wanted: 1920s-1960s. Amplifiers, mixers, pre-amps, speakers, tubes, etc. FREE OFFER 1-800-251-5454.

NEEDED: WATER cooled induction heaters, hi-voltage supplies, variable 0-60KV, 0-10mA. Contact lan, phone 864-882-6580.

WANTED: USED Translux personal ticker. Write: W. Hunt, PO Box 181, Grand Portage, MN 55605.

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. KEYWAYS, INC., 937-847-2300 OR fax 937-847-2350.

WANTED: TUBES, radios, transmitters, receivers, gyros, bearings, connectors, relays, lamps, synchros. Hyness Company, 709B Delair Road, Cranbury, NJ 08512-4212. Phone: 609-395-1116, FAX 609-395-1117.

WANT USED or surplus DC motor controls or adjustable frequency AC drives, 1/2 HP and up. DC motors fractional to 3 HP. C. Woodruff, 5507 55th Ave. S., Seattle, WA 98118. Voice/Fax 206-723-8487.

WANTED: AVIONICS test equipment, IFR, 600A, 401L, others, Collins, King, Sperry, North Atlantic, Litton INUs LTN series, rate and tilt tables, air data test sets, 941-625-3222 P, 941-625-0494 F, E-Mail: avionics@afcon.net

WANTED: MANUAL/parts/programming software for Uniden UHF handheld model #SPU480K. Call Bill at 610-587-4107.

### BBS & ONLINE SERVICES

### **EDUCATION**

RF OSCILLATOR DESIGN. Learn to design RF oscillators from a pro. Unique course for hobbyists, students, and engineers presents the knowhow of RF oscillator analysis, simulation and design with experiments. Requires AC/DC and some calculus. \$25 + \$5 S&H. RFLS, PO Box 9185, Gaithersburg, MD 20898-9185. Free information: E-Mail: rfls@world net.att.net phone 301-528-6671.

# BUSINESS OPPORTUNITIES



COUNTER-SURVEILLANCE=\$250 HR! Electronic eavesdropping is unbelievably widespread! Are you sure you're safe? Learn how others (without prior experience) earn \$250 HR in the fascinating field of COUNTER-SURVEILLANCE! For FREE catalog call: 1-800-732-5000.

### REPAIRS — SERVICES

PICS, GALS READ if you've lost your masters. Programming service available. Call for info. Network Sales, 616-683-0500.



TZPC-175 Converters





THE BEST DEALER PRICING



Centurion: CF-3000

(Brand New)

True, 99-Channel

20-lot

✓ Call for other models

✓ One stop shop

✓ Same day shipping

✓ One full year warranty

Intek Electronic Systems 405-634-1535

Write in 58 on Reader Service Card.

ENGINEERING CONSULTING. Product development from conceptual to manufacturing stages. Digital, analog, and RF expertise. Microcontroller designs for HC05xx, HC11xx, and PIC families. Software design for IBM PC. XILINX and Altera FPGA design. Inhouse schematic capture and PWB. Hicks Electronic Design, PO Box 7366, Loveland, CO 80537-0366. Toll Free 1-888-849-6792 E-Mail: steve@hickseng ineering.com website: www.hickseng ineering.com

PC BOARDS REPAIRED. Prices start at \$5. Minimum 5 of one type. Network Sales, 616-683-0500.

RADIO REPAIR! Reasonable charges. Jim Rupe, 998 Whipple, Grayland, WA 98547-0697. 360-267-4011. E-Mail: w7ddf@yahoo.com

PRINTED CIRCUIT design by professional with 30+ years: conventional, multilayer, downhole, fine line. Prototype and production fabrication. Reverse engineer existing 2-layer board. Toll free 877-236-3223. www.circuitapplied-tech.com

CABLE CONVERTER REPAIR: Quality repair service for all name brands. If you're tired of the runaround you're getting from the company you purchased it from, or they're out of business. Give us a call for fast and courteous service, Have model and problem ready. Sorry no box, chip, or IL repairs. Highview Engineering 815-245-3735 or E-Mail: HIGHENG1@AOL.COM ask for George.

PC BOARD ASSEMBLY. Thru hole only. Small or large quantities OK. Call Network Sales. 616-683-0500.

(E)EPROM PROGRAMMING done quickly and economically. One day turn around typical. Simple copy \$3 per device. Also prototyping, design, and consulting services available. Call or send SASE to: Luzer Electronics, 4023 North Bayberry, Wichita, KS 67226. 316-687-2127, FAX 316-687-3103.

PATENT YOUR HARDWARE/SOFT-WARE INVENTIONS. Experienced registered patent agent can help you. Quick, efficient, economical, confidential service. Call 909-599-0801.

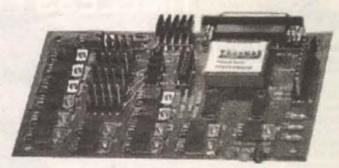
Subscribe to
Nuts & Volts
on the web and
take advantage
of our special
subscription offer.
http://www.nutsvolts.com
For new
subscribers OR
renewals!

### ADDRESSABLE STEPPER MOTOR CONTROLLER

The PARAMAX stepper motor controller is PC parallel port based addressable controller capable of simultaneous operation of 4 uni-polar stepper motors ranging in voltages from 5 to 12 volts at up to 2 amps per phase. The PARAMAX stepper motor controller includes 8 digital inputs with a data through put rate of 500k bytes per Using the unique PARAMAX second. addressing method, up to 256 controllers can simultaneously function from parrallel port. The programming package includeslibraries that allow you to create applications both under Windows and DOS. Included libraries are: C++, Pascal, Delphi, Basic and utilities for DOS and Windows.

> Also available at: FORD ELECTRONICS, INC (714) 521 - 8080

\$199.95



PARAMAX INC. (800) 473 - 8080

Come and visit us on the internet at: www.paramax.net

# Unen Granne

## A Little Digression: A "Boatanchor" Kit

Every now and

then, I like to

engage in a little

whimsical fancy

related to my pas-

sion for old radios. I

collect old radios

and naturally gravi-

tate towards any-

thing pertaining to

old radios ...

So when Frank at Ocean State Electronics [6 Industrial Drive, Westerly, RI 02891; 401-596-3080 (voice) and 401-596-3590 (FAX); 1-800-866-6626 (orders)] told me he had some new kits based on vacuum tube technology I had to bite (or is that "byte" in this computer age).

The kit that I got from Ocean State was the Vintage Radio Kit Company (427 North Main Street, Sharon, MA 02067) CP5TR Cakepan Transceiver Kit (Figure 1). To make matters more interesting, it is built on a cake pan. I recall building on cake pans and pie tins in the early days before we could afford aluminum chassis (uhhh ... my mother didn't know ...), so I was doubly intrigued.

The kit consisted of the cake pan and cover, and a collection of parts. Some of the parts were already mounted. Tube sockets, for example, were mounted using a soldering process. Other parts (transformers, switches, potentiometers, and capacitors) you will have to mount.

The bands are changed between 80 and 40 meters by manually changing coils. The front panel controls include: RF gain, key/mike, regen, main tuning, fine tuning, and a mode switch that selects between Spot, CW 5W, CW 1W, and AM. On the left side of the cake pan is a control that selects the AM carrier level. Along the read panel are: Audio out, hum balance, fuse, AC line, and the SO-239 UHF connector used for the antenna. Because this transceiver kit is crystal-controlled on transmit, you will be limited to a few frequencies for which you have crystals. Normally, the crystals used are HC-6/U types. although you can add FT-243 if you would like them.

The plate tuning capacitor ("Final Tune") is used as a preselector in the receive mode and plate loading of the 6AQ5 transmitter stage in transmit. Tuning the transmitter is simplicity itself; tune for maximum output using the Final Tune control. The main receiver controls are the Regen, Main Tuning, and Fine Tuning controls. The two tuning controls are connected together so they form a pair. They are highly

interactive, so one must learn to operate them together.

The Regen control means regeneration is used. This controls the point of regeneration. The more regeneration it puts into the circuit, the less sensitive the receiver. It is standard practice to operate this control near the edge.

For AM detection, the regenerative action should go over into oscillation ... but not quite there. For CW operation, you will find the level experimentally, but close to oscillation is a good place to

The RF gain control does double duty as the power on/off control. The RF gain control is used to set the RF gain of the receiver so that it does not overload on strong signals.

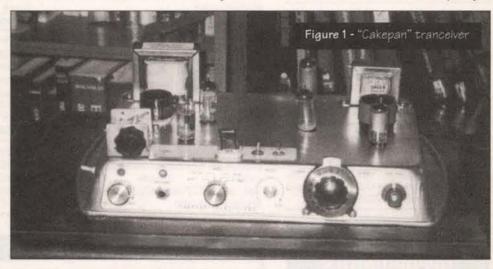
The top of the chassis has more than just tubes and transformers, it contains a CW audio filter and a clipper circuit. The CW audio filter should only be used with headphones. It will attenuate load adjacent signals (while reducing audio generally).

The audio clipper is used only for removing the loud "thumping" sound in the receiver output while sending CW. There are three positions to the switch: hard, soft, and off. The soft position is especially useful for eliminating atmospheric noise.

The front panel controls contain a combination mike/key quarter inch phone plug. Wire the ring on the phone plug for the microphone, and tip to the push-to-talk (assuming you are using the Astatic D-104 "chrome lollipop" type of microphone or its equivalent).

The spec sheet for the CP5TR Cakepan Transceiver lists 12 hours as the assembly time. It took me a few hours longer (about 15 hours). The receiver specifications include ham band coverage plus 75 KHz, with 100 KHz on 40meters. The transceiver can be used on 160-meters, 80/75-meters, and 40meters (coils come for all three bands). Tuning rate is 8:1 with velvet smooth vernier tuning and fine tuning of ±6 KHz. The audio output is 750-mW into an 8-ohm headphone (which is plenty). Receiver drift test after a five minute warm-up; 600 Hz in one hour, 200 Hz drift per hour after that point.

The transmitter puts out 5 watts, but is switchable to 1 watt. The transmitter is crystal-controlled (Pierce oscillator). The carrier is 1.5 watts on AM, and it is cathode modulated. Audio quality is



### **5 Axis Robotic Arm Kit** \$195.00 Plus S&H



We have many more cool robots, check out our web page or ask for our free catalog! 3 Axis Version \$155.00 • Mobile Version \$250.00 • Mobile Robots Book \$32.00

Lynxmotion, Inc. 104 Partridge Road Pekin, IL 61554-1403 USA http://www.lynxmotion.com



Tel: 309-382-1816 Fax: 309-382-1254

sales@lynxmotion.com tech@lynxmotion.com **Equipment Management Technology** 



Tel 650-631-1700 Fax 650-631-1200 Email sales@emt1.com

### SELECTED SPECIALS!

O.	LLLOI	LD OI LOIA	LU.
HP 16505A	\$250	HP E1345A	Make Offer!
HP 16510A	\$100	HP E1347A	Make Offer!
HP 16515A	\$100	HP E1364A	Make Offer!
HP 16516A	\$400	HP E1400B	Make Offer!
HP 3314A	\$1400	HP E1401A	Make Offer!
HP 5335A	\$500	HP E1662A	Make Offer!
HP 59501B	\$250	HP E1671A	Make Offer!
HP 6266A	\$250	HP E1672A	Make Offer!
HP 8016A	\$500	HP E1681A	Make Offer!
HP 83545A	\$3850	HP E1682A	Make Offer!
HP 8493B	\$100	HP E1693A	Make Offer!
HP 8958A	\$5000	HP E1725A	Make Offer!

956 Bransten Road

San Carlos, CA 94070

We buy, rent, and sell high quality test and measurement products. We occasionaly offer great deals on computers as well.

HP OmniBook 600C color subnotebook weighs a mere 3.7lbs for ultimate portability. Special Nuts & Volts price is only \$250!

> Dave is test equipment! Bigdave@emt1.com

Kerry is computers! kwhite@emt1.com

Open Channel

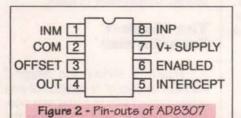
"... unrestricted 20 Hz to 10 KHz" although you will probably want to restrict the bandpass to 3,000 Hz.

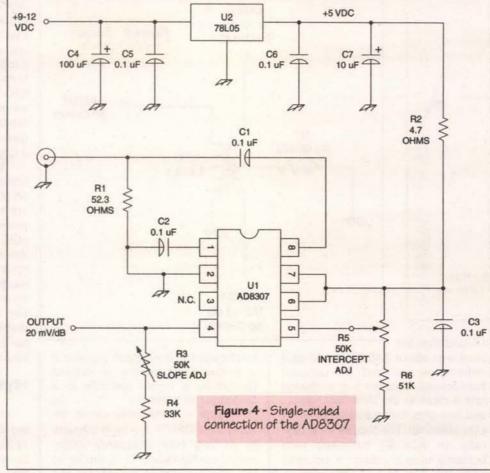
The pictorials for the kit are a little crude, in fact they are hand drawn. They are adequate to the purpose, however. There were two negative aspects to this kit. First, the knobs came through with no set screws (one knob had the set screw), but that was easily overcome with some RadioShack knobs. The second downer was that the SO-239 holes were not drilled correctly. Two of the four holes lined up, but two were off by quite a bit. A quick drill job fixed the problem.

My conclusion is that the CP5TR Cakepan Transceiver is a very interesting "old-new" technology kit. It's very worth-while and provided me with a good diversion for a week or so of evenings.

## More on the AD8307 Chip

The AD8307 is a log compression amplifier made by Analog Devices, Inc. [One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106; 781-329-4700 (voice), 781-326-8703 (FAX), and http://www.analog.com (web site)]. The chip uses a method of serial logarithmic compression in which each stage provides a little bit of the total compression (92 dB) to provide a DC 500 MHz chip. A cascade chain





of six logarithmic amplifiers provides the lower two-thirds of the dynamic range of the device, while a series of three "top-end detectors" provide the upper third of the dynamic range. The chip provides a 25 mV/dB output with a -75 dBm to +17 dBm range.

With a single supply of 2.7 volts minimum (5 volts is more common, 5.5 volts is the maximum), it will operate with only 7.5 mA of DC current. The input signal path is DC coupled and differential. The input impedance is 1,100 ohms with 1.4 pF in parallel with it.

The pin outs (Figure 2) are as follows:

1. INM - Signal input, negative

polarity

2. Common

3. Offset alignment

4. Out

5. Intercept — Adjusts intercept ±6 dB

Enabled – CMOS compatible Chip Enable (active-HIGH)

7. V+ supply (2.7 volts to 5.5

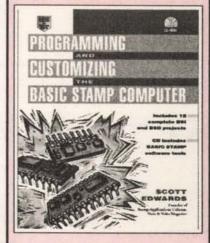
INP — Signal input, positive polarity

Figure 3 shows the basic connections for the AD8307 chip (without offset connection). The input section is coupled through capacitors C1 and C2 (a pair of 0.001 µF units). These capacitors ought to be SMD (surface mount) types if very high fre-

quencies (VHF) are anticipated. The normal high frequency cut-off of disk ceramic capacitors is too low for this chip because the chip produces -3 dB gain to 500 MHz.

The output section places a resistance in series with the output terminal and passes a current through it to produce 25 mV/dB output function. By placing potentiometer R1 and R2 in the circuit, we do two things. First, reduce the gain to 20 mV/dB. And

# Order 7oday!



### "PROGRAMMING AND CUSTOMIZING BASIC STAMP COMPUTERS"

### by Scott Edwards

Build smart electronics projects with the inexpensive, simple-to-use, surprisingly powerful BASIC Stamp.

ONLY \$34.95

As a paid subscriber to Nuts & Volts, you'll receive 10% off the list price!!

(See ad on page 6 for ordering details and other titles currently available.)

## 2 Great Books by Joseph Carr



### SECRETS OF RF CIRCUIT DESIGN

rom one of today's most respected electronics authors comes this pragmatic,

intermediate-level guide to designing, building, and testing all types of radio frequency circuits. Filled with functional projects that demonstrate the principles of RF circuits, this revision of a bestseller also provides a handy parts list and sources of components.

### PRACTICAL ANTENNA HANDBOOK

he most popular book on antennas ever written, widely known as "the antenna builder's bible."

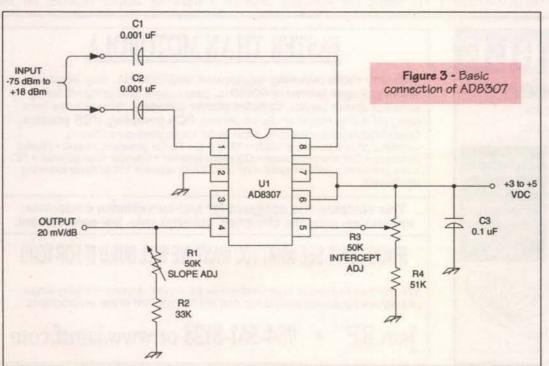


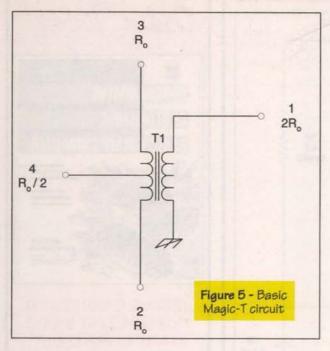
This Third Edition is a work for anyone with an interest in antennas, from the newest of novices to the most experienced engineer. This empowering book gives you all kinds of projects and material that explains why what you did works.

As a paid subscriber to

Nuts & Volts, you'll receive 10% off
the list price!!

(See ad on page 6 for ordering details and other titles currently available.)





OUT-2 0° -3 dB Figure 6 - Better 50 OHMS Magic-T circuit INPUT 50 OHMS **R1** 25 OHMS IF. OUT-1 180º -3 dB 50 OHMS

second we provide control over the output slope. The circuit works without the R1/R2 combination, but it is highly recommended if you desire a calibrated output. This network is in parallel with the internal network, which accounts for the reduced output function.

The intercept can be adjusted at pin no. 5 over a range of ±6 dB (this pin is also optional, but highly recommended). There is a certain amount of ambiguity relative to both the output and the intercept point, and the two potentiometers are design features that permit adjustment to a much smaller ambiguity function. As a result, both are highly recommended in cases where output and intercept integrity are desirable features.

I am intrigued with this chip, and have built several projects based on it.

One of my projects was an RF decibel meter (based on a foreign magazine article) from Stippler-Electronik, Inh. [Postfach 1109, D-86656, Bissingen, Germany] in Europe. This kit is priced in deutchmarks, but with credit card ordering,

I found that the

price was about \$40.00 (credit card ordering is preferred for overseas transactions because the exchange rate is close to the New York rate ... and one gets the protection of credit card ordering). The Stippler kit is basically an AD8307 front-end with buffered output circuit. It operates from 100 KHz to 110 MHz with an error of < 1 dB, with an output scale factor of 10 mV/dB. The input of the kit is 50 ohms.

Other uses for the AD8307 include field strength meter with dB output, cable driving amplifier, 1 µW to 1 kW RF power meter, 120-dB measurement system (which depends on the properties of an AD603 amplifier), bandpass frequency meter, and low frequency dB

The field strength meter application is particularly intriguing to me. The circuit uses a pair of antennas that total one-meter in length, with the feedpoint in the center. The circuit in Figure 3 can be used for the field strength meter. The capacitors are increased to 0.01 µF for high frequency operation. A digital voltmeter

can be used as the output indicator if a portable instrument is desired (portability is highly desirable in a field strength meter!).

Figure 4 shows the circuit for using the AD8307 in a high frequency or Very High Frequency singleended configuration. It is similar to the previous circuit except for the input details. The signal is applied to the positive input (INP) through capacitor C1, while the negative input is grounded through capacitor C2. The input impedance is 50 ohms when combined with the internal 1,100-ohm impedance because of the 52.3-ohm resistance. You will have to hand select this resistor from either a pair of 100-ohm resistors, or a 51-ohm resistor (either one can be a five percent resistor). Otherwise, just forget it and use a 51-ohm resistor in this slot ... it will result in a small mismatch.

### Lightning Detector — Revisited

A number of readers contacted me about the lightning detector

project. I failed to give the gains of the amplifiers in the article. Actually, that was intentional because the gain will depend on the nature of the oscilloscope used. If you have a very sensitive oscilloscope, then use X1 to X50 for the amplifiers. If the oscilloscope used is low sensitivity (an older model), use X50 to X500 for the gains. As you can see, there is quite a large range of gains required!

In most cases, ordinary operational amplifiers can be used for the amplifiers. DC differential amplifiers are needed, and the gain must be provided over about 50 KHz. This puts the devices used clearly within the range of CA-3140 or CA-3240 op-amps. These are high-frequency models. You can't use ordinary 741 op-amps for this application because the frequency compensation (that makes them "unconditionally stable") keeps the bandpass down to a few Kilohertz.

### **Hybrid Couplers**

Hybrid couplers are an interesting class of devices. The most interesting property is that they will split an input power two ways. Each of these outputs receives -3 dB of the input power (i.e., a two-way split). Some hybrids produce in-phase outputs, others (called "quadrature" hybrids) produce 90-degree outputs, and others produce 180-degree (outof-phase) outputs. There are a number of devices that are useful, but among those that I find most interesting are the Magic-T devices. We will take a look at the fascinating Magic-T. The Magic-T produces 180degree, out-of-phase outputs.

### The Magic-T **Transformer**

Figure 5 shows the Magic-T transformer hybrid. It consists of one center-tapped winding and one nontapped winding; which is used as the input or output depends on the

## WHOLESALE CABLE

### COMPLETE LINE OF CABLE PRODUCTS

- ☑ Quality merchandise by brand name manufacturers
- ☑ Satisfaction guaranteed ☑ Free gift on first order
- ☑ Technical support
- ☑ 2 year warranty on new converters
- ☑ COD shipping & overnight shipping by request best price you
- ☑ Experience where it counts ☑ Volume pricing

PLAIN CONVERTERS: ZENITH, OAK, PANASONIC, PIONEER, EAGLE, HAMLIN, STARGATE, PLUS MORE.

REMOTE CONTROLS: ALL MAJOR BRANDS, **INCLUDING 2-4 FUNCTION UNIVERSAL REMOTES** 

WHOLESALE CABLE M-F 11am-6pm EST (718) 206-0879 (718) 262-0900 · FAX (718) 657-4015 · (718) 297-9221

No NY sales. Federal and local laws provide criminal and civil penalties for unauthorized use. Check with your cable providers for permission to use equipment. Must be paying for all services you receive. Order by model number only. Some equipment

let us try to beat it.

Tell us the

were offered,

where you got

it from, and

## FASTER THAN MOTOROLA

Two-way radio jamming equipment 800/900MHz. Stop illegal surveillance. Pager jammers 900MHz. Stop pagers from going off during school or church service. Cellular phone jammers. Stop cellulars from going off during school or church service. PCS jamming, PCS phones. Lojack/teletrack/boomerang. Stop illegal tracing/anti-surveillance. Cordless phone jammers 49MHz/900MHz • Radar jammers Xband • Nextel jammers • Car alarm jammer • CB radio jammer • Garage door jammer • RC radio jammers • AM/FM radio • HF/VHF/UHF radios • 1/8000MHz jamming

This equipment is designed for anti-surveillance customers: embassies, schools, churches, governments, law enforcement.

## IF YOU DON'T SEE WHAT YOU WANT, WE WILL BUILD IT FOR YOU!!

We sell only to specific organizations or for export. Anyone implying illegal activity will be denied assistance and will be reported to law enforcement.

Jam RF • 954-561-8128 or www.jamrf.com

application. The relationship of the impedances is shown in Figure 5. The system impedance, Ro, appears at the ends of the center-tapped winding (Port 2 and Port 3), while the impedance at the tap (Port 1) is Ro/2. The impedance at the ungrounded end of the non-tapped winding (Port 4) is 2Ro.

Let's take a look at two situations. First, a signal is applied to Port 1. If Ports 2 and 3 are properly terminated in the system impedance, then the power will split 3 dB to each port, but the voltage appearing at the two ports is 180° out of phase. Port 3 is thus 180° with respect to Port 2. Both Port 2 and Port 3 are -3 dB with respect to the input level. Because Port 4 is the common between ports 2 and 3, the voltage is zero, so Port 4 is the isolated port.

The next case would be a signal applied to Port 4. This signal is split two ways, -3 dB each to Port 2 and Port 3. The signal at Port 1 will be zero because equal but opposite currents from Port 1/Port 2 and Port 1/Port 3 are induced into the untapped winding, thus canceling each other.

### Practical 50-Ohm Example

The combiner/splitter shown in Figure 6 is designed for 50-ohm systems, so the tap is terminated in a 25-ohm non-inductive resistor. The input is the non-tapped winding. In order to reduce the 100-ohm impedance that one would expect from the previous case, where the turns ratio is 1:1, the turns ratio is adjusted to 1.414:1 although, in practice, a 1.5:1 ratio is normally used. This transforms the impedance to close to 50

A different approach to input impedance transformation is to use a transformer to couple the output. The circuit is otherwise similar to the previous circuit, except that the transformer turns ratio is the same as the straight Magic-T, i.e., 1:1. A second transformer is used to transform the 100-ohm impedance reflected from the tapped winding to 50 ohms. The transformer is an autotransformer, i.e., a transformer made with a single tapped winding rather than two windings. The tap is placed at the two-thirds point from ground.

### Construction

The Magic-T can be built for any power level using appropriate toroidal ferrite or powdered iron cores for transformer T1. For receiveonly Magic-Ts you can use cores such as the T-50-2 and T-50-6 in the 1 to 30 MHz high frequency (HF) region, or T-50-15 in the 100 KHz to 15 MHz medium wave region. For receiver applications, use #24 AWG or #26 AWG enameled wire.

For QRP transmitters, you can

use a core of the same material (the "dash number" in the type numbers above), but should increase the size to something between the 100 (1inch) and 240 (2.4-inch) sizes. Use wire in the #22 AWG to #18 AWG, or larger, if power levels are more than a few watts.

If you build one for transmitting at higher power, then you will need to use one of the larger hybrids commonly found on high power BALUN transformers. Also, scale the wire size up according to the power level

One of the applications of this type of coupler is to combine the signals from two antennas. Although any type of antenna can be used, let's consider the case of the quarter wavelength vertical spaced a half wavelength apart. These can be fed either in-phase or 180 degrees outof-phase, depending on the direction that you want to squirt signal. A high power Magic-T and some switching can be used for feeding the antenna.

Why? One fellow told me that he would simply use a half wavelength extra of coax to the 180 degree antenna, and that would take care of the phase shift. Yes, it would, but it also distorts the pattern. Loss in the coaxial cable means that the two antennas will receive different currents, and that messes up the radiation pattern. By using the Magic-T device, you can use equal lengths of identical coaxial cable to the two antennas. If you want to feed them in-phase, then don't use the Magic-T. But if you want to feed them out of phase, connect the Magic-T into the circuit such that Port 2 and Port 3 goes to the two antennas, and Port 1 goes to the transmitter.

### Science Fair Participants and Judges

Once again, I put out a plug for participating in your local science fair if you are a student, and judging science fairs if you are an adult. I participate in several local fairs every year and find it very rewarding (as a judge ... I am a little past the age where one can participate!). This is the season for creating the types of projects that will generate a little interest at your local fair, so why not do one of these projects and enter it? I have written in this column before regarding the things it takes to win a science fair, so I will not bore you with the details again except to say that participation is a good thing. NV

### Connections ...

I can be reached by snail mail at P.O. Box 1099, Falls Church, VA 22041, or via E-Mail at CARRJJ@AOL.COM.

## Digital Storage Oscilloscopes From \$99.00

ATC modules turn your PC into a full-function DSC, spectrum analyzer, logger, & DVM. Units DC to 50MHz. O-Scope II now in Windows 3.1, 95/98, NT and DOS.

O-Scope Ip O-Scope II Specialty probes \$189. \$349. call.







ATC is a stocking distributor for Pico Technology LTD which offers scope modules to 100MSPS, resolutions from 8 to

Pico offers PC based data loggers from 1 to 22 channels, 8 to 16 bit and the Environon environmental monitoring system.

Pico products - call

The DFA-5, low cost differential amplifier, cuts through common mode noise problems to reveal low voltage signals. With NEW gains from 1X to 1000X and band widths from 20KHz to 1.2MHz, DFA-5 is the test accessory to help you work with signals from DFA5 5 Volts to 5 microVoltes. Only \$129.00.

Serial Port Problems??? Check out Serial!! Our lowcost serial channel analyzer only \$99.00.

Allison Technology Corporation 2006 Finney Vallet Rd., TX. 77471 U.S.A. 800-980-9806 or 281-239-8500

http://www.atcweb.com atc@accesscomm.net

## ALLTECH ELECTRONICS

WWW.COMPUTERCHOPPER.COM

WE CHOP Price\$!



SCSI **CDROM** 

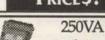
Matsushita / Apple OEM PC or Mac SCSI

4x \$19 24x \$79



486 Mini System

486SX25 • Great for Linux DX266 Upgradable • 2 ISA Slots • VGA, LPT, 2COMs • FD \$29



Isolation

Transformer 115V Pri - 115V 250VA Sec Magnetek Triad 6" x 4" x 5"



10"Open Frame SVGA

10" SVGA

Metal Enclosed - Displays Up to 1024 x 768 • 110V AC Also Available in a standard case. \$129

The same 1024x768 .26dp

monitor but with a slight burn in

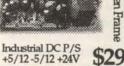
spot in the center.
Our Pain is Your Gain! \$59



7 SCSI CD's in a Tower 7 CR-504-L

Drives in a SCSI Tower case - 50 Pin \$179

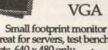




9" Mono



Adapter For Motorola Flip Phone and compatable. Use ANY landline device,



Great for servers, test benches etc. 640 x 480 only. \$39 \$49 modem, fax, etc. Refurbished.

### 9.75" Mono, 8.6" and 10.4" Color LCDs



Great for Servers: ISA Controller Included!! All screens are 640x480. The controller supports 256 Colors. 9.75" Mono Passive.....\$89.00 9.5" Color Passive.....\$199.00 10.4" Color Active ......\$319.00 Touch Screen Option Available.

See our web site for more details.

Cheaper Ethernet Stuff Industrial Surplus PC Parts • Mac Parts

For more information on these products and hundreds of other products check out:

www. ComputerChopper .Com

760/724-2404 Fax 760/724-8808 Computer Circulation Center, Inc.

Mon-Fri 9AM -5:30PM - Or see us on the internet.

VISA • Mastercard • Discover • American Express

Prices & Availability subject to change without notice • Government & Educational PO's Accepted. • Not Responsible for Typographical Errors

TYPE or PRINT your ELECTRONICALLY RELATED ad copy CLEARLY (not all caps) on a separate piece of paper. Spell out words when submitting handwritten copy. Calculate the number of words and multiply it by the appropriate rate (see RATE PER WORD section). Include any charges for bold and/or CAPPED words, any artwork costs that would be applicable, and/or costs for boxing your ad (explained below). Choose the appropriate classification for your ad(s) to appear in (see below). If no classification is indicated, it will be placed in Misc. Electronics or wherever we deem most suitable. Enclose your name, address, phone number, and Nuts & Volts account number from your mailing label (if available) for identification purposes. Include full payment - CLASSIFIEDS RUN ON A PRE-PAID BASIS ONLY - and mail your completed order to:

NUTS & VOLTS MAGAZINE, 430 Princeland Ct., Corona, CA 91719.

### RATE PER WORD

The ad rate for current PAID subscribers is 60¢ per word. All others pay \$1.20 per word. There is a \$9.00 minimum charge per ad per insertion.

### WORDS IN BOLD AND/OR ALL CAPS

Words to be set in **bold** or CAPS are each 10¢ extra PER WORD. BOLD CAPS are 20¢ extra per word. The first two words of each ad are bold capped at no charge. Indicate bold words by underlining. Words normally written in caps (e.g., IBM) and accepted abbreviations such as VAC or MHz are NOT charged as all cap words. Use a two-letter abbreviation for states.

### PHOTOS, DRAWINGS, AND BOXES

A photo or drawing may be run at the top of your classified ad for an additional \$10.00 (1" depth max.) for camera-ready art. No wording is allowed in this area. Add a one-time charge of \$5.00 to enlarge, reduce, or duplicate line art, or \$8.00 for halftone of photographs. To BOX your ad, include an additional \$50.00 for copy-only ads, or \$75.00 for ads with art or photos.

You may fax in ad copy or changes before the closing date (5:00pm on the 5th) at 909-371-3052 using MasterCard or Visa. Include credit card expiration date, the name that appears on the card, a daytime phone number, and your Nuts & Volts account number. Ads without credit card information will not be listed as received until payment is received in full. WE DO NOT CALL OR FAX BACK VERIFICATION OR QUOTES OF FAXED-IN ADS. For verification of faxed-in ads, please call 909-371-8497.

### DEADLINE

Prepaid ads received by 5:00pm on the closing date (5th of the month) will appear in the following month's issue. Ads postmarked through the 5th, but received after the closing date, will be placed in the next available issue. No cancellations or changes after the 5th. Cancellations and changes must be submitted in writing.

### IMPORTANT INFORMATION

All classified ads are running copy only. No special positioning, centering, dot leaders, extra space, etc. is allowed. All advertising in Nuts & Volts is limited to electronically related items ONLY. All ads are subject to approval by the publisher. We reserve the right to reject or edit any ad submitted. We do not take ad copy or changes over the phone. We do not bill for classified ads. Repeat ads or ads run in multiple classifications within the same issue are allowed. Paid subscribers may run ads at the 60¢ rate only through their subscription expiration date. NO REFUNDS. Credit only. No credit for typesetting errors will be issued unless you clearly print or type your ad copy.

Choose a category for your ad from the classifications listed below.

- 10. Ham Gear For Sale
- 20. Ham Gear Wanted
- 30. CB/Scanners
- 40. Music & Accessories
- 50. Computer Hardware
- 60. Computer Software
- 70. Computer Equipment Wanted
- 80. Test Equipment
- 85. Security
- 90. Satellite Equipment
- 95. Military Surplus Electronics
- 100. Audio/Video/Lasers
- 110. Cable TV
- 115. Telephone/Fax

- 120. Components
- 125. Microcontrollers
- 130. Antique Electronics 135. Aviation Electronics
- 140. Publications
- 145. Robotics
- 150. Plans/Kits/Schematics
- 155. Manuals/Schematics Wanted
- 160. Misc. Electronics For Sale
- 170. Misc. Electronics Wanted
- 175. BBS & Online Services
- 180. Education
- 190. Business Opportunities
- 200. Repairs/Service

## **ADVERTISER'S INDEX**

Abacom Technologies16	EDS52	Linear Systems15	Risk Free Disks, Inc.	85
ABC Electronics58	E.H. Yost & Co70	Lynxmotion, Inc62	Roger's Systems Specialist	19
ACP Super Store60	Electro Mavin25	M2L Electronics14	Saelig Company	31
ActiveWire, Inc84	Electro Science Applications, Inc58	Matco, Inc84-85		
Alfa Electronics41	Electro Tool, Inc57	MCM Electronics27		
All Electronics Corporation75	Electronic Goldmine87	Meredith Instruments14	Seabird Technical	
Allison Technology Corporation65, 84	Electronic Products84	Metric Equipment Sales, Inc25	The second secon	
Alltech Electronics65	Electronix Express41	microEngineering Labs49	Sescom, Inc.	
Alltronics	EMAC, Inc59	Micromint78		
AM Research, Inc59	EPS85	Midland Technologies84		
Andromeda Research12	Equipment Management Technology62	Milestone Products32	Skycraft Parts & Surplus, Inc	57
Antique Radio Classified85	ExpressPCB9	Modern Communications76	softwarecloseouts.com	85
AST Global Electronics69	Fair Radio Sales Co39	Mr. NiCd70	Square 1 Electronics	9
Astro Too	Foss Warehouse Distributors86	MSC Electronics85	SuperCircuits	33
Aventrade86	Fusion Electronic Security54	MVS15		
BasiConcepts, Inc79	Gateway Electronics, Inc38	Netcom21		
Baylin Publications79	General Device Instruments86	Norcomm23	Technological Arts	
Bilocon Corp85	Gibraltar Trade Center, Inc55	Northwest Cable & Connector Co70		
Brick Wall Div., Price Wheeler Corp30	Globaltech Distributors84	Optoelectronics4	Technology Electronics, Ltd	
Brigar Electronics12	Graymark10	OS Systems51	Telulex, Inc.	
C & S Sales, Inc11	Halted Specialties Co3	Parallax, Inc Back Cove		
C and H Sales Company56	H.T. Orr Computer Supplies59	PARAMAX, INC61		
Circuit Chem, Inc85	Hyatt Electronics51	PCW, Inc78	Timeless Products	60
Circuit Specialists, Inc94	Information Unlimited74	Phelps Instruments83	3 Unicorn Electronics	48
Consumertronics39	Inkjet Southwest42	Pioneer Hill Software48	Upstate Games	85
Corporate Systems Center2, 95	Intek Electronic Systems61	Polaris Industries	USI Corp	57
Cunard Associates60	intelligence85	Power Quality, Inc86		
Cyber-Test Incorporated16	Intronics, Inc56	Prairie Digital, Inc85	Velleman	
Davilyn Corp55	Jade Products, Inc86	Pulsar, Inc24	Vesta Technology, Inc.	
Decade Engineering84	Jameco Electronics92	Quality Kits84		
DeMar Electronics85	Jam RF64	R & S Surplus77		
Digital Products Company84	Junkware.com84	Ramsey Electronics, Inc40	Weeder Technologies	
Direct Factory Supply, Inc82	J-Works, Inc88	Rapid LLC20	Western Test Systems	34-35
DMD Systems Recovery, Inc85	La Paz Electronics Int'l56	R.E. Smith84	Wholesale Cable	64
Earth Computer Technologies36	Lemos International Co., Inc71	Resources Un-Ltd28	8 Worldwyde	86

	DMD Systems Recovery, Inc85	THE RESERVE OF THE PARTY OF THE	
AMATEUR RADIO & TV	DMD Systems Recovery, Inc85 Earth Computer Technologies36 Electro Mavin25	What you	
Alltronics13	General Device Instruments86		
Astro Too 85	Gibraltar Trade Center, Inc		
Gateway Electronics, Inc	Halted Specialties Co		ed.
Jade Products, Inc	MCM Electronics27		e
Norcomm23	Northwest Cable & Connector Co70 Risk Free Disks, Inc85	OH	
Ramsey Electronics, Inc	Roger's Systems Specialist19		
The Till Collineation	Roger's Systems Specialist 19 Shreve Systems 26 Techniks, Inc. 84	nat	
ASSEMBLY SERVICES	Upstate Games85	W.	10
	Software		1 ( )
Bilocon Corp85	AM Research, Inc		
BATTERIES/CHARGERS	Electro Science Applications, Inc58 Gibraltar Trade Center, Inc55		
Contraction of the Contraction o	Globaltech Distributors84 Pioneer Hill Software48		
Aventrade	softwarecloseouts.com85		1
E.H. Yost & Co70	Microcontrollers / I/O Boards		
Globaltech Distributors84 Jade Products, Inc86	AM Research, Inc		200
Mr. NiCd70	BasiConcepts, Inc79 EMAC, Inc59		BY PRODUCT CATEGORY
Power Quality, Inc86	Jameco Electronics92		A Procor
BUSINESS	Junkware.com		By LEG
OPPORTUNITIES	Micromint	Charles of the Arthurs	67
	OS Systems 51	A STORY OF THE STO	CI
Intek Electronic Systems61	Parallax, Inc	THE RESERVE OF THE PARTY OF THE	CARLES AND SECTION
BUYING	Prairie Digital, Inc85 R.E. Smith84		Total and the last
ELECTRONIC SURPLUS	Scott Edwards Electronics, Inc		
	Technological Arts	EPS85	
ABC Electronics		Fourinment Management Technology 62	SOLAR EQUIPMENT
C and H Sales Company	Printers/Printer Supplies	Fair Radio Sales Co. 39 Halted Specialties Co. 3 Hyatt Electronics 51	SSEATT EQUIT INETT
EDC RE	Printers/Printer Supplies H.T. Orr Computer Supplies	Hyatt Electronics	
Equipment Management Technology62 Intek Electronic Systems61 Metric Equipment Sales, Inc25 Roger's Systems Specialist19 Skycraft Parts & Surplus, Inc57	The state of the s	Linear Systems15	STEPPER MOTORS
Metric Equipment Sales, Inc25	DESIGN/ENGINEERING	Power Quality, Inc. 86 Resources Un-Ltd. 28	
Roger's Systems Specialist	SERVICES	Shreve Systems	Alltronics
		Surplus Traders 86 Unicorn Electronics 48	TATIANIAA, INC.
CABLE TV	Electro Science Applications, Inc58 ExpressPCB9	Visitect, Inc39	TELEPHONE
THE RESIDENCE OF THE PARTY OF T	Midland Technologies 84	Weeder Technologies83	TEEE HORE
Direct Factory Supply, Inc82 Foss Warehouse Distributors86	Prairie Digital Inc. 85	PROGRAMMERS	Digital Products Company84
Milestone Products32	Pulsar, Inc24 V&V Mach. & Equipment, Inc84-86	PHOGHAWIWIENS	Globaltech Distributors84 Telulex, Inc
Modern Communications	EDUCATION	Andromeda Research12	Weeder Technologies83
Sam's Electronics	EDUCATION	Electronic Products	STATE OF THE PARTY
Wholesale Cable64	BasiConcepts, Inc	Intronics, Inc	TEST EQUIPMENT
Worldwyde86	EMAC, Inc59	microEngineering Labs	ADO Floritorios
CB/SCANNERS	Rapid LLC20		ABC Electronics
The state of the s	EVENTS/SHOWS	PUBLICATIONS	Allison Technology Corp65, 84
USI Corp57		Antique Radio Classified85	AST Global Electronics 69 Astro Too 85
COD CAMEDACAUDEO	ACP Super Store	Consumertronics 39	C & S Sales, Inc
CCD CAMERAS/VIDEO		intelligence 85 Netcom 21 Square 1 Electronics 9	Circuit Specialists, Inc94
Circuit Specialists, Inc94	KITS	Square 1 Electronics9	Davilyn Corp
Decade Engineering84 Fusion Electronic Security54	Alltronics	RF TRANSMITTERS/	DMD Systems Recovery, Inc85
Matco, Inc84-85	C & S Sales, Inc11	RECEIVERS	EDS 52 Electro Tool, Inc. 57
MSC Electronics85 Polaris Industries7	Digital Products Company	HECEIVENS	Equipment Management Technology62
Ramsey Electronics, Inc	Electronic Products84	Abacom Technologies16	Intronics, Inc
Seabird Technical85	EMAC, Inc		MCM Electronics
SuperCircuits	Information Unlimited74	ROBOTICS	Optoelectronics4
THE RESERVE OF THE PERSON NAMED IN	Jade Products, Inc	Astro Too	Phelps Instruments
COMPONENTS	Quality Kits	Astro Too	Power Quality, Inc86
BasiConcepts, Inc	Scott Edwards Electronics, Inc52	Lynxmotion, Inc.         62           OS Systems         51           PARAMAX, INC.         61	Prairie Digital, Inc
Electronic Goldmine	SiGEM84 Technology Electronics, Ltd86	PARAMAX, INC	Saelig Company
Electronix Express41 EPS85	USI Corp57		Sescom, Inc84
Hyatt Electronics	Velleman	SATELLITE	Telulex, Inc17
La Paz Electronics Int'l56			Test Equipment Plus
Linear Systems 15 OS Systems 51	LASERS	Baylin Publications	THE RESERVE OF THE PERSON NAMED IN COLUMN 2 IS NOT THE OWNER.
Pulsar, Inc. 24 SiGEM 84	Information Unlimited74	SiGEM	TOOLS
Skycraft Parts & Surplus, Inc	Meredith Instruments		C & S Sales, Inc11
Visitect, Inc	Unicorn Electronics48	SECURITY	Electro Tool, Inc57
	Harris of the latest and the latest	Europa Floatronia Populiti	Graymark
COMPUTER	MISC./SURPLUS	Fusion Electronic Security54 Information Unlimited74	The RF Connection49
Hardware		intelligence	WIRE/CABLE
Hardware ACP Super Store60	All Electronics Corporation	Matco, Inc	& CONNECTORS
ActiveWire, Inc84 Allison Technology Corp65, 84	Brigar Electronics	Norcomm23	THE RESIDENCE OF THE PARTY OF T
Alltech Electronics	Circuit Chem, Inc85	Polaris Industries	Northwest Cable & Connector Co70
Brick Wall Div., Price Wheeler Corp30	Consumertronics	Visitect, Inc39	Roger's Systems Specialist19 The RF Connection49
Consumertronics	DéMar Electronics		
January 20			

# Luestions & Answers

This is a READER TO READER Column. All questions AND answers will be provided by Nuts & Volts readers and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and NO GUARANTEES WHATSOEVER are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

### QUESTIONS

I need an inexpensive volume control circuit that could connect to the tape in/out jacks on my stereo remote volume control. [Momentary press of a push-button switch to raise volume, momentary press of a second push-button switch to lower volume.) Or, a source of lowcost commercial unit to do this, perhaps infrared remote.

10991 Jim Farago Minneapolis, MN

I need help in obtaining service literature for Dictograph model #100/101 circa 1955.

10992 Art Heyman Apple Valley, CA

I am interested in mastering both the theory and practice of programmable logic controllers (PLCs). Can anyone recommend good training hardware and some good textbooks?

10993

Thomas Ng San Jose, CA

I need to project the image from an 8mm camcorder tape onto a screen larger than a television screen. This is for a club with a number of people viewing it. I have thought of using an old optical movie camera (8mm) photographing the television screen and showing this through a projector.

Obviously, there would be losses doing this, the worst being loss of sound. Can anyone suggest a technique for accomplishing this?

10994

**Charles Forman** San Diego, CA

I am looking for a source of 434 MHz miniature TV transmitters. Any ideas?

10995

Rich Roznoy Westport, CT

I am searching for a program to read a DS1820 in Visual Basic RS232.

10996

Pierre Verreault via Internet

I need to locate a hard drive caddy (the frame/casing which the hard drives mounts in, and which has the connector that mates with the body of the computer) for a Dell

Send all material to Nuts & Volts Magazine, 430 Princeland Court, Corona, CA 91719, OR fax to [909] 371-3052, OR E-Mail to forum@nutsvolts.com

Latitude 433MC laptop. Dell no longer supports this model, and they were not able to suggest any thirdparty sources that sell this item.

Any suggestions on vendors that I might be able to purchase this from?

10997

Mike Kluger via Internet

I have a JVC prologic receiver with a bad transformer in it. I cannot locate the company or any replacement info on this part. It has a shorted primary coil and labeled with: ETP1200-62JAJ. BANDO. BD21A10-0008, and BEM1-0FA.

10998

Rick Horne via Internet

I am seeking a schematic/parts list/parts placement list for a Gateway Monitor CS11572FS. Also need identity to a part [rectifier?] numbered exactly as follows: 3H 15DF8

I have the horizontal waves traveling up the screen.

Besides the resistor R331, any other likely parts? I need to fix at least one.

10999

Nicholas I. Oshana, Jr. via Internet

Does anyone know the pinouts for the Sony HVM-302 Watchman Camera?

It should be 6V DC positive, negative, audio, and video. However, I don't know which is which, and I don't want to damage the unit by using the trial and error method.

109910

**Eric Dubiel** St. Clair Shores, MI

I have acquired a Compaq Portable III (one of those lunchbox computers), but unfortunately the information on this beast is hard to

Compaq has a listing of parts, most of which are, of course, out of stock. It runs fine, but I have plans ...

However, I am primarily interested if anyone has information on the plasma display. The cabinet interior has plenty of room to pull out the other components and make a nice luggable Linux box.

109911

Coyt D. Watters via Internet

I need program code numbers and instructions for extended transmit frequencies for my Dai AT-600 dual band transceiver.

109912

Clarence via Internet

I am using a Bearcat BC235XLT "Trunk Tracker" portable scanner with a (BNC) rubber duck when in

My main areas of listening are VHF lo/high band, aircraft, police, fire and rescue, V/DOT crews (during the winter), VA Power, and REA/Southside Electric Cooperative during power failures.

I would like to experiment with the used/junked TV/FM antennas for reception when at home, and at the same time save alot of money.

What kind of TV/FM antennas have omni directional reception capabilities, as well as the fixed-position types used to aim at the source of the broadcast signal?

I have picked up the Chesterfield (VA) 800MHz Trunked system using just a set of "rabbit-ears" using an N to BNC adapter.

109913

Sean Amelia, VA

I am desperately seeking a schematic on how to build a battery load tester. Preferably, a sealed leadacid type used in the alarm industry. Something that would be switchable from 4 to 7 amphour, 12 VDC, and would have three simple LED readouts, for good, fair, and bad.

109914

Michael Hussar via Internet

I recently bought a Leviton DHC X-10 Inductive Dimmer Switch module from Smarhome.com. The ad says it's especially good for fans and transformers, and other inductive

I tried it on my ceiling fan and it worked, but it caused an annoying hum, loudest at high speeds. The hum is coming from the motor, and it's just loud enough to be annoying in a fairly quiet room.

Their tech support said that's common in some fans, and offered to refund my money, but I really want to see if I can get rid of the hum.

I am considering replacing the

### **ANSWER INFO**

 Include the question number that appears directly below the question

you are responding to.
• Payment of \$25.00 will be sent if your answer is printed.

In most cases, only one answer per question will be printed.

Your name, city, state, and E-Mail address, (if submitted by E-Mail), will be printed in the magazine, unless you notify us otherwise with your submission.

 Due to space limitations, we can not reprint the original questions with the answer. The question number and the issue it appeared in are printed above the answer.

 Unanswered questions from a past issue may still be responded to.

Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows

### QUESTION INFO

### TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:

1) Circuit Design 3) Problem Solving

2) Electronic Theory 4) Other Similar Topics

### INFORMATION/RESTRICTIONS

 No questions will be accepted that offer equipment for sale or equipment wanted to buy.

 Selected questions will be printed one time on a space available basis.

Questions may be subject to editing.

### HELPFUL HINTS

Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).

Write legibly [or type]. If we can't read it, we'll throw it away.

Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

triac inside of it with a Teccor "Alternistor." Digi-Key P/N Q2015L6-ND. The description for it says it has "been specifically designed for applications which are required to switch highly inductive loads, and has better turn-off characteristics than a triac."

Would this improve the hum? Is it safe to attempt this kind of modification? I am familiar with DC motor back-EMF and the common countermeasures, but not with AC motors.

109915

Randy Gamage Rocklin, CA

## **ANSWERS**

### ANSWER TO #7996 - JULY 1999

I need a source to obtain a Gauss meter to measure emissions of electric applicances, buildings, fields, etc.

For your application, you will probably want an extremely-low-frequency (ELF) triaxial Gauss meter. There are three suppliers that I know

> Alphalab, Inc. 1280 S. 300 W. Salt Lake City, UT 84101 801-487-9492

F.W. Bell/Teslatronics 6120 Hanging Moss Rd. Orlando, FL 32807-3798 1-800-775-2550

Walker Scientific, Inc. Rockdale St. Worchester, MA 01606 508-852-3674

> Ross Wollrab Des Plaines, IL

### ANSWER TO #9995 - SEPT. 1999

I mounted an electric window system in my car. The driver's window used to go automatically up or down - a complete course - at a single touch of the button. Now, this system is broke. I have to keep pushing the button to completely open the window

I want to make a circuit that would keep the motor running until the window opens completely, and then turn it off

Without building an elaborate sensing circuit, you can couple a latching relay and feed the power that runs and holds this relay on, through a simple flasher relay. Using a two-bulb flasher will give you approximately a two to three amp trip value while an emergency flasher unit will give you up to five amps [or more) power before tripping.

Most car window motors run between a couple of amps and perhaps five amps max and, while the power is fed through a simple flasher unit it will run the motor and latch the relay that is feeding this motor. When the motor reaches the top position and virtually jams, the amperage draw will go up and overload the bi-metal switch and it will pop, thus dropping the latch part of the latching relay, and then it will reset in the off position.

These flasher relays are designed to overload and reset almost indefinitely, or at least for years on end without damaging the

They make great circuit breakers, but they are better than the ordinary circuit breaker in that they

are designed to cycle on and off continuously and indefinitely without damage. Also, fuse the entire circuit to around 10 or 15 amps at the feed panel to protect the wiring overall.

There is a drawback to this design of all the way and stop, and that is when someone gets stuck in the window, and it takes a half second to shut off. Even your original design doesn't deal with this adequately.

> Chris Bieber, CA

### ANSWER TO #99914 - SEPT. 1999

I am looking for a way to keep my car engine at about 1,000 RPMs while I have my A/C on.

My car is a 1977 Plymouth Fury station wagon (land yacht) with A/C. The engine is a 360CC two-barrel carb., eight cylinder.

Every year, I have to put up with a battery going dead because the alternator drops out at low RPMs and the car also overheats due to slow fan when the RPMs are low.

If AC came stock on your car, everything you need to keep your idle up when the AC is on, is already there. Remove your air filter assembly, and look at the base of the carb. You should see a solenoid which has one wire coming out of it. That solenoid when powered, will extend and bump your idle speed up. Reasons it might not be working could be adjustment (it just screwed in), or it could be disconnected or possibly nonfunc-

Apply power to it and see if it extends. If not, replace it. If it does, hunt down the fuse/fusible link for it.

John M. Hoyt Easley, SC

### ANSWER TO #99921 - SEPT. 1999

I am looking for a circuit design for a ISO-9141-2 to RS-232 converter to allow me to see the information coming out of the On Board Diagnostic II system found on all '96 and higher Chrysler and import vehi-

One place you might want to check out is www2.ari.net/avt-inc. They sell OBDII adaptors and software

Dan Hockey via Internet

### ANSWER TO #9998 - SEPT. 1999

I am building a robotics platform using two stepper motors for loco-

Is there any formula for figuring how much weight a stepper motor can carry, and also two together?

The weight that a motor can handle is determined by its torque. For example, if a motor is specified at 20 ounce-inches, then the motor can lift 20 ounces with a pulley radius of

# AST GLOBAL ELECTRONICS

24529 STATE HWY. 408, CAMBRIDGE SPRINGS, PA 16403 VOICE 814-398-8080 · 1-888-216-7159 · FAX 814-398-1176

### VIEW COMPLETE LISTING AT: http://www.astglobal.com

IF WE DON'T CARRY IT ... WE'LL FIND IT QUICKLY ... AT REASONABLE PRICES.

,	
EIP 545, Microwave Counter 18GHz.	\$500 HP 6294A, Power Supply, 0-60V @ 1A (metered)
EIP 931, Microwave Source, .01-18GHz, Opt. 9320 \$	
Fluke 845AB, Null Detector/Micro Voltmeter 1uV-1000VDC	
Fluke 3330B, Constant Current/Voltage Calibrator	
Fluke 5100B, Multifunction Calibrator, Opt. 03/05\$	
Fluke 5100B, Multifunction Calibrator	
Fluke 5200A, Programmable AC Calibrator	H 000 /10Uhi w00024 Output Amp witcons & 4 5400
Fluke 5215A, Precision Power Amp	
Fluke 6070A, Synthesized RF Signal Generator	
200KHz-520MHz	HP 8160A, Programmable Pulse Generator, 50MH
Fluke 8050A, DMM 4-1/2 Digit w/Battery Pack	
Fluke 8050A, DMM 4-1/2 Digit w/o Battery Pack	
Fluke 8520A, DMM 5-1/2 Digit Fluke 9010A, Micro System Troubleshooter	\$275 HP 8445B, Auto Preselector, 1.8-18GHz
General Radio 1658, Digibridge	
Gigatronics 6061A, Synthesized Signal Generator	HP 8614A, Signal Generator, 800-2400MHz, AM/FI
10KHz-1050MHz	
HP 141T, Spectrum Analyzer Mainframe	
HP 141T, Spectrum Analyzer w/8552A/8553B, 1KHz-110MHz \$	
HP 141T, Spectrum Analyzer w/8552B/8553B, 1KHz-110MHz \$	
HP 141T, Spectrum Analyzer w/85528/8556A, 20Hz-300KHz \$	1,100 HP 8640B, Signal Generator, .5-1050MHz, Opt. 00
HP 141T, Spectrum Analyzer w/8552B/8554B, 1KHz-1.2GHz \$	
HP 141T, Spectrum Analyzer w/8552B/8555A, 10MHz-18GHz \$	1,900 HP 8656A, Synthesized Signal Generator, 100KHz
HP 214A, Pulse Generator, .08V-100V	\$200 HP 8743A, Reflection Test Set, 2-12.4GHz
HP 334A, Distortion Analyzer HP 339A, Distortion Analyzer w/Low Distortion Oscillator	\$950 UP 50303A D/A Convertor
HP 400EL, AC Voltmeter, 10Hz-10MHz	
HP 400FL, RMS Voltmeter, 20Hz-4MHz, 100uV-300V	\$175 (metered)
	Kepco JQE 36-15MVPT, Power Supply, 0-36 @ 15
	W 100 10 00 00 00 00 00 00 00 00 00 00 00
TURN IDLE TEST EQUIPMEN	Krohn-Hite 3202R, Dual Channel Tunable Filter, 20
- INTO CASH -	High Pass, Low Pass Band Reject
CALL OR FAX FOR QUOTATION	
CALL ON TAX FOR GOOTATION	PG506A, Calibration Generator Plug-in
	Power Designs 2K-10 HV PS 1-2000V@10MA
HP 415E, SWR Meter.	Racal Dana 1991, Counter/Timer, 2 Channel
HP 415E, SWR Meter.  HP 432A, Power Meter w/Cable/8478, .01-18GHz Sensor.	
	I ROUNGE TO TOLEY , LOUIS THE LOT MILE
HP 436A, Power Meter w/8481H Sensor/Cable\$	The state of the s
HP 436A, Power Meter, Opt. 002/009/022 w/8481H	Resolution
SensoriCable\$	areas and a supplied to the su
HP 651B, Test Oscillator, 10Hz-10MHz.	
HP 6528, Test Oscillator, 10Hz-10MHz.	\$125 Sencore SC81, Scope (100MHz) w/New Probes, D
HP 654A, Oscillator, 10Hz-10MHz, 90dB Attenuator	
HP 1630D, Logic Analyzer w/pods	
HP 1630G, Logic Analyzer w/pods	\$650 Senonra VGQ1 Universal Virter Generator
HP 3312A, Function Generator, .1Hz-13MHz	\$490 Sorenson DCR-80-5A, Power Supply, 80V @ 5A
HP 3314A, Function Generator, Opt. 001\$	1,500 (metered)
HP 3325A, Programmable Frequency Synthesizer 1Hz-32MHz	\$950 Tek 7S14, Plug-in Sampling Plug-in, DC-1GHz
HP 3330B, Automatic Synthesizer, 20Hz-13MHz	\$295 Tak AMSOT Olyania On Amo
HP 3400A, True RMS Voltmeter, 10Hz-10MHz, 1mV-300V	\$125 Tak AM502 Plun-in Differential Amn
HP 3406A, RF Voltmeter, 50uV-3V, 1,2GHz	\$200 Tal DCC02 Dive in Country I leiunger   100HUs
HP 3455A, DMM 5-1/2 Digit	\$250 Tek DC509, Plug-in Counter, 135MHz, UNUSED .
HP 3456A, DMM 6-1/2 Digit	\$525 Tol Disco Diss is DANA
HP 3466A, DMM 4-1/2 Digit, AC/Battery, 5 Function	\$175 Tek DM502, Plug-in DMM
The second secon	THE LIMITED PROPERTIES

New in box wimanual\$2	75
New in box wimanual. \$2 HP 8011A, Pulse Generator, 1Hz-20MHz. \$1 HP 8013B, Pulse Generator, 1Hz-50MHz. \$2 HP 8015A, Pulse Generator, 1Hz-50MHz 30V. \$4 HP 8091A, Rate Generator (1GHz) w/8092A Delay Generator (1GHz) w/8093A Output Amp w/15401A & 15400A. \$1,00 HP 8160A, Programmable Pulse Generator, 50MHz, Opt. 001. \$8 HP 8160A, Programmable Pulse Generator, 50MHz.	75
HP 80138, Pulse Generator, 1Hz-50MHz	75
HP 8015A Pulse Generator 1Hz-50MHz 30V \$4	nn
LID 8001A Data Concentra (1CUs) w/0002A Delay Concentra	~
14 OUT IN TOO SE CHIEF AND WIS FROM A STREET	-
[1GP2] WOUSSA OUIDULAMP W15401A & 15400A\$1,00	00
HP 8160A, Programmable Pulse Generator, 50MHz, Opt. 001 \$80	50
HP 8160A, Programmable Pulse Generator, 50MHz,	
Opt. 001/020. \$1,00 Opt. 001/020. \$1,00 HP 8165A, Programmable Sig Source, 1milliHz-50MHz. \$88 HP 8445A, Tracking Generator, 1101z-110MHz. \$22 HP 8445B, Auto Preselector, 1.8-18GHz. Opt. 002/003 \$37 HP 8601A, Sweeper Generator, 1-110MHz. AMFM Leveled. \$94 HP 8614A, Signal Generator, 800-2400MHz, AMFM Leveled. \$94 HP 8614A, Signal Generator, 1845 184, 65474, 31-15861	00
HP 8165A, Programmable Sig Source, 1milliHz-50MHz \$95	50
HP 8443A Tracking Generator 1KHz-110MHz 97	75
LID BAASD Auto Decelertor 1 9.19CU:	75
UD 04450, Aut December 4 6 40011 Oct 000000	10
HP 8445B, Auto Preselector, 1.8-18GHz Opt. 002/003 \$3	75
HP 8601A, Sweeper Generator, .1-110MHz\$4	00
HP 8614A, Signal Generator, 800-2400MHz, AM/FM Leveled \$30	00
HP 8616A, Signal Generator UHF, 1.8-4.5GHz, +10-126dB,	
AMFIM \$3  AMFIM \$3  HP 8620C, Frame w/86222B Sweeper .01-2.4GHz \$1,11  HP 8620C, Frame w/86222B Sweeper .01-2.4GHz \$1,11  HP 86202D, RF Puly 1n, 5.9-9.0GHz  HP 8640B, Signal Generator, 5.1650MHz, Opt. 002/001 or 003 \$1,81  HP 8656A, Synthesized Signal Generator, 100KHz-990MHz \$1,44	00
LID 9690C Frome w/969229 Cureanay 01.2 ACUs #1 til	50
UD 000400, Plante Widoczeb dweeper UT-E-Work	20
nr 802420, nr Piug-in, 5.9-9.0GHz	a
HP 8540B, Signal Generator, .5-1050MHz, Opt. 002/001 or 003 \$1,80	00
HP 8640B, Signal Generator, .5-512MHz, Opt 001 or 003 \$70	00
HP 8656A, Synthesized Signal Generator, 100KHz-990MHz \$1.40	00
HP 8743A, Reflection Test Set, 2-12.4GHz. \$20 HP 8901A, Modulation Analyzer Opt. 010 \$85 HP 59303A, D/A Converter \$12 Kepco ATE15-50M, Power Supply, 0-15V @ 50A	00
LID 00018 Maddation Analysis Oct 010	70
FIF COUTA, MODULATION ARBITYZOF OPT. 010	(0
HP 59303A, D/A Converter	25
Kepco ATE15-50M, Power Supply, 0-15V @ 50A	
(metered)	00
Kepco JQE 36-15MVPT, Power Supply, 0-36 @ 15A (metered) \$21	75
Kepco JQE 36-3MVPT, Power Supply, 0-36 @ 3A (metered) \$17	75
Krohn-Hite 3202R, Dual Channel Tunable Filter, 20Hz-2MHz,	
NUMETING SOUCH, DUGI CHARMEI TURBURG PRIOR, 20172-2MITZ,	
High Pass, Low Pass Band Reject	00
National Instruments GPIB-100A, Bus Extender	75
PG506A, Calibration Generator Plug-in\$\$(	00
High Pass, Low Pass Band Reject.         \$2           National Instruments GPIB-100A, Bus Extender         \$11           PG506A, Calibration Generator Plug-in.         \$8           Power Designs 2K-10 HV PS 1-2000V@10MA         \$37	75
Racal Dana 1991, Counter/Timer, 2 Channel	75
Bacal Dana 1997, Counter/Timer 1CUs	75
	15
Dealford (ANOC D1111 - Chee	
Rockland 1022F, Dual Hi/Lo Filter \$13	25
Racal Dana 1992, Counter/Timer, 1GHz. \$57 Rockland 1022F, Dual Hi/Lo Filter \$12 Rockland 5100, Synthesizer, DC-2MHz, 001 Hz	25
Rockland 1022F, Dual Hil/Lo Filter	25 25
Rockland 1022F, Dual Hi/Lo Filter	25 25 00
Rockland 1022F, Dual Hill.o Filter \$11  Rockland 5100, Synthesizer, DC-2MHz, ,001 Hz Resolution \$33  Sencore CM2000, Computer Analyzer \$PECIAL \$1,46  Sencore LC102, Capacitor/Inductor Analyzer \$98	25 25 00 50
Rockland 1022F, Dual Hill.o Filter \$11  Rockland 5100, Synthesizer, DC-2MHz, ,001 Hz  Resolution \$33  Sencore CM2000, Computer Analyzer SPECIAL \$1 All Sencore LC102, Capacitor/Inductor Analyzer \$98  Sencore SC81, Soope (100MHz) whitew Probes, Dual Trace \$77	25 25 00 50 50
Resolution SS Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$90 Sencore SC81, Scope (100MHz) whitew Probes, Dual Trace \$77	25 00 50 50
Resolution \$3.  Sencore CM2000, Computer Analyzer SPECIAL \$1.40  Sencore LC102, Capacitor/Inductor Analyzer \$4.  Sencore SC81, Scope (100MHz) while w Probes, Dual Trace \$7.  Sencore SC81, Scope (100MHz) wide Probes, Dual Trace \$4.	25 00 50 50
Resolution \$3.  Sencore CM2000, Computer Analyzer SPECIAL \$1.40  Sencore LC102, Capacitor/Inductor Analyzer \$4.  Sencore SC81, Scope (100MHz) while w Probes, Dual Trace \$7.  Sencore SC81, Scope (100MHz) wide Probes, Dual Trace \$4.	25 00 50 50
Resolution . SPECIAL \$1,40 Sencore CM2000, Computer Analyzer . SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer . \$98 Sencore SC81, Scope (100MHz) with Probes, Dual Trace . \$78 Sencore SC81, Scope (100MHz) with Probes, Dual Trace . \$40 Sencore TVA92, TV Video Analyzer . \$1,10 Sencore VA93, Universal Video Generator . \$1,20 Sencore VA93, Universal Video VA94, VA9	25 00 50 50
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$78 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20	25 00 50 50 50 00 00
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$78 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20	25 00 50 50 50 00 00
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$78 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20	25 00 50 50 50 00 00
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$78 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20	25 00 50 50 50 00 00
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$78 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20	25 00 50 50 50 00 00
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$78 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20	25 00 50 50 50 00 00
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$78 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20	25 00 50 50 50 00 00
Resolution. Sencore CM2000, Computer Analyzer	25 00 50 50 50 00 00 75 225 775 225
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$7 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Sorenson DCR-80-5A, Power Supply, 80V © 5A (metered). \$37 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$47 Tek AM501, Plug-in Off Plug-in Dferential Amp. \$27 Tek DC503, Plug-in Counter, 135MHz, UNUSED \$31 Tek DC509, Plug-in Counter, 135MHz, UNUSED \$31 Tek DC509, Plug-in Counter, 135MHz, UNUSED \$31 Tek DC509, Plug-in Counter, 135MHz, UNUSED \$31	25 00 00 50 00 00 00 75 225 50 775 225
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$88 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$7 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Sorenson DCR-80-5A, Power Supply, 80V © 5A (metered). \$37 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$47 Tek AM501, Plug-in Off Plug-in Dferential Amp. \$27 Tek DC503, Plug-in Counter, 135MHz, UNUSED \$31 Tek DC509, Plug-in Counter, 135MHz, UNUSED \$31 Tek DC509, Plug-in Counter, 135MHz, UNUSED \$31 Tek DC509, Plug-in Counter, 135MHz, UNUSED \$31	25 00 00 50 00 00 00 75 225 50 775 225
Resolution	25 25 26 20 20 20 25 25 25 25 25 25 25 25 25
Resolution	25 25 26 20 20 20 25 25 25 25 25 25 25 25 25
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$98 Sencore SC81, Scope (100MHz) withew Probes, Dual Trace \$78 Sencore SC81, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Sorenson DCR-80-5A, Power Supply, 80V 69 5A (metered). \$37 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$46 Tek AM501, Plug-in Op Amp. \$17 Tek AM502, Plug-in Differential Amp. \$22 Tek DC509, Plug-in Counter, 135MHz, UNUSED \$17 Tek DM502, Plug-in DMM. \$11 Tek DM502, Plug-in DMM. \$12 Tek DM502, Plug-in DMM. \$12 Tek DM502, Plug-in DMM. \$13 Tek DM502, Plug-in DMM. \$12 Tek DM502, Plug-in DMM. \$12 Tek DM502, Plug-in DMM. \$13 Tek DM502, Plug-in DMM. \$12 Tek DM502, Plug-in DMM. \$13 Tek DM502, Plug-in DMM. \$12 Tek DM502, Plug-in DMM. \$13	25 25 20 20 20 20 20 20 20 20 20 20
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/inductor Analyzer \$98 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$4 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Soneson DCR-80-5A, Power Supply, 80V 9 5A (metered) \$1,20 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$4 Tek AM501, Plug-in Differential Amp \$1 Tek AM502, Plug-in Differential Amp \$2 Tek DC503, Plug-in Counter Universal, 100MHz \$1 Tek DC509, Plug-in Dounter, 135MHz, UNUSED \$3 Tek DM502, Plug-in DMM \$1 Tek FG504, Plug-in DMM \$1	25 25 20 20 20 20 20 20 20 20 20 20 20 20 20
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/inductor Analyzer \$98 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$4 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Soneson DCR-80-5A, Power Supply, 80V 9 5A (metered) \$1,20 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$4 Tek AM501, Plug-in Differential Amp \$1 Tek AM502, Plug-in Differential Amp \$2 Tek DC503, Plug-in Counter Universal, 100MHz \$1 Tek DC509, Plug-in Dounter, 135MHz, UNUSED \$3 Tek DM502, Plug-in DMM \$1 Tek FG504, Plug-in DMM \$1	25 25 20 20 20 20 20 20 20 20 20 20 20 20 20
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/inductor Analyzer \$98 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$4 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Soneson DCR-80-5A, Power Supply, 80V 9 5A (metered) \$1,20 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$4 Tek AM501, Plug-in Differential Amp \$1 Tek AM502, Plug-in Differential Amp \$2 Tek DC503, Plug-in Counter Universal, 100MHz \$1 Tek DC509, Plug-in Dounter, 135MHz, UNUSED \$3 Tek DM502, Plug-in DMM \$1 Tek FG504, Plug-in DMM \$1	25 25 20 20 20 20 20 20 20 20 20 20 20 20 20
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/inductor Analyzer \$8 Sencore SC81, Scope (100MHz) with Probes, Dual Trace \$7 Sencore SC81, Scope (100MHz) with Probes, Dual Trace \$4 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Sorenson DCR-80-5A, Power Supply, 80V 9 5A (metered) \$1,20 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$4 Tek AM501, Plug-in D Amp \$1 Tek AM502, Plug-in Differential Amp \$2 Tek DC503, Plug-in Counter Universal, 100MHz \$1 Tek DC509, Plug-in Dounter, 135MHz, UNUSED \$3 Tek DM502, Plug-in DMM \$1 Tek FS504, Plug-in DMM \$1 Tek PS501-1, Plug-in Power Supply \$1 Tek PS501-1, Plug-in Power Supply   \$1 Tek PS503A, Plug-in Power Supply   \$1	25 26 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/inductor Analyzer \$8 Sencore SC81, Scope (100MHz) with Probes, Dual Trace \$7 Sencore SC81, Scope (100MHz) with Probes, Dual Trace \$4 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Sorenson DCR-80-5A, Power Supply, 80V 9 5A (metered) \$1,20 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$4 Tek AM501, Plug-in D Amp \$1 Tek AM502, Plug-in Differential Amp \$2 Tek DC503, Plug-in Counter Universal, 100MHz \$1 Tek DC509, Plug-in Dounter, 135MHz, UNUSED \$3 Tek DM502, Plug-in DMM \$1 Tek FS504, Plug-in DMM \$1 Tek PS501-1, Plug-in Power Supply \$1 Tek PS501-1, Plug-in Power Supply   \$1 Tek PS503A, Plug-in Power Supply   \$1	25 26 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/inductor Analyzer \$8 Sencore SC81, Scope (100MHz) with Probes, Dual Trace \$7 Sencore SC81, Scope (100MHz) with Probes, Dual Trace \$4 Sencore TVA92, TV Video Analyzer \$1,10 Sencore VG91, Universal Video Generator \$1,20 Sorenson DCR-80-5A, Power Supply, 80V 9 5A (metered) \$1,20 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$4 Tek AM501, Plug-in D Amp \$1 Tek AM502, Plug-in Differential Amp \$2 Tek DC503, Plug-in Counter Universal, 100MHz \$1 Tek DC509, Plug-in Dounter, 135MHz, UNUSED \$3 Tek DM502, Plug-in DMM \$1 Tek FS504, Plug-in DMM \$1 Tek PS501-1, Plug-in Power Supply \$1 Tek PS501-1, Plug-in Power Supply   \$1 Tek PS503A, Plug-in Power Supply   \$1	25 26 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer Sencore LC102, Capacitor/Inductor Analyzer Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer. \$1,10 Sencore VG91, Universal Video Generator \$1,20 Sencore VG91, Universal Video Generator (unused) \$1,20 Sencore	25 26 26 26 27 27 27 27 27 27 27 27 27 27 27 27 27
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$8 Sencore CM2000, Computer Analyzer \$8 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore VG91, Universal Video Generator \$1,20 Sorenson DCR-80-5A, Power Supply, 80V © 5A (metered). \$1,10 Sorenson DCR-80-5A, Power Supply, 80V © 5A (metered). \$3 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$4 Tek AM501, Plug-in Do Amp. \$1 Tek DC503, Plug-in Counter, 195MHz, UNUSED \$3 Tek DC503, Plug-in Counter, 195MHz, UNUSED \$3 Tek DC509, Plug-in DMM. \$1 Tek DM502A, Plug-in DMM. \$1 Tek DM502A, Plug-in Function Generator, 001-40MHz; \$1 Tek PG504, Plug-in Power Supply \$1 Tek PG501, Plug-in Power Supply \$1 Tek PG503, Plug-in Power Supply \$1 Tek PG503A, Plug-in Power Supply \$1 Tek PG503A, Plug-in Toxicion Generator, 001-40MHz; \$1 Tek PG503A, Plug-in Power Supply \$1 Tek PG503A, Plug-in Toxicion Generator, 001-40MHz; \$1 Tek PG503A, Plug-in Power Module, \$10 Tek PG504A, Plug-in Pu	25 25 26 20 20 20 20 20 20 20 20 20 20
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer \$8 Sencore CM2000, Computer Analyzer \$8 Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore VG91, Universal Video Generator \$1,20 Sorenson DCR-80-5A, Power Supply, 80V © 5A (metered). \$1,10 Sorenson DCR-80-5A, Power Supply, 80V © 5A (metered). \$3 Tek 7514, Plug-in Sampling Plug-in, DC-1GHz \$4 Tek AM501, Plug-in Do Amp. \$1 Tek DC503, Plug-in Counter, 195MHz, UNUSED \$3 Tek DC503, Plug-in Counter, 195MHz, UNUSED \$3 Tek DC509, Plug-in DMM. \$1 Tek DM502A, Plug-in DMM. \$1 Tek DM502A, Plug-in Function Generator, 001-40MHz; \$1 Tek PG504, Plug-in Power Supply \$1 Tek PG501, Plug-in Power Supply \$1 Tek PG503, Plug-in Power Supply \$1 Tek PG503A, Plug-in Power Supply \$1 Tek PG503A, Plug-in Toxicion Generator, 001-40MHz; \$1 Tek PG503A, Plug-in Power Supply \$1 Tek PG503A, Plug-in Toxicion Generator, 001-40MHz; \$1 Tek PG503A, Plug-in Power Module, \$10 Tek PG504A, Plug-in Pu	25 25 26 20 20 20 20 20 20 20 20 20 20
Resolution. Sencore CM2000, Computer Analyzer SPECIAL \$1,40 Sencore LC102, Capacitor/Inductor Analyzer Sencore LC102, Capacitor/Inductor Analyzer Sencore SC61, Scope (100MHz) withew Probes, Dual Trace \$7 Sencore SC61, Scope (100MHz) with Probes, Dual Trace \$1,40 Sencore TVA92, TV Video Analyzer. \$1,10 Sencore VG91, Universal Video Generator \$1,20 Sencore VG91, Universal Video Generator (unused) \$1,20 Sencore	25 25 26 20 20 20 20 20 20 20 20 20 20



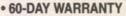
Tek FG504, Plug-in Function Generator, J001-40MHz\$375
Tek PG501, Plug-in Pulse Generator, 5Hz-50MHz\$175
Tek PSS01-1, Plug-in Power Supply \$150 Tek PSS03A, Plug-in Power Supply Triple \$175
Tek PS503A, Plug-in Power Supply Triple\$175
Tek OlG-502, Plug-in Optical Impulse Generator (unused) \$500
Tek T922, Scope (15MHz), Dual Trace, nice\$175
Tek TM503, Power Module, 3 Slot
Tek TM504, Power Module, 4 Slot
Tek TM506, Power Module, 6 Slot
Tek TR503, Plug-in Tracking Generator, 100KHz-1.8GHz \$575
Tek 2213, Scope (60MHz), Dual Trace
Tek 2215, Scope (60MHz) Dual Trace
Tek 2230, Scope (100MHz) Digital Storage SPECIAL \$1,600
Tek 2235, Scope (100MHz) Dual Trace \$650 Tek 2236, Scope (100MHz) w/Counter/Timer/DMM. \$850
Tek 2236, Scope (100MHz) w/Counter/Timer/DMM
Tek 2246, Scope (100MHz) 4-Channel Cursor RO SPECIAL \$1,200
Tek 2247A, Scope (100MHz) Dual Trace w/
Counter/Timer/Voltmeter
Tek 2336, Scope (100MHz) Dual Trace SPECIAL \$525
Tek 2445, Scope (150MHz), 4-Channel Cursor Readout \$1,100
Tek 2445A, Scope (150MHz), 4-Channel Cursor Readout \$1,400
Tek 2465, Scope (300MHz), 4-Channel Cursor Readout \$1,400
Tek 453, Scope (60MHz), Dual Trace
Tek 465, Scope (100MHz), Dual Trace
Tek 465B, Scope (100MHz), Dual Trace\$475
Tek 466, Scope (100MHz storage), Dual Trace\$575
Tek 475, Scope (200MHz), Dual Trace
Tek 475A, Scope (250MHz), Dual Trace\$625
Tek 485, Scope (350MHz), Dual Trace
Tek 520A, NTSC Vectorscope\$400
Tek 576, Curve Tracer\$1,900
Tek 7104, Scope (1GHz), Dual Trace\$1,200
Tek 7104, Scope (1GHz) w/7A29, 7A29, 7B10 & 7B15 \$2,200
Tek 7844, Scope (dual beam) w/7A24, 7A26, 7B80 & 7B87 \$750
Tek 7904, Scope w/7A24, 7A26, 7B80 & 7B85
Tek 7904A, Scope w/7A24, 7A26, 7B80 & 7B85
Tek 7904A, Scope (500MHz) Frame\$425
Valhalia 2724A, Program. Res. Standard w/Manual
Wavetek 145, Pulse/Function Generator, .0001-20MHz\$300
Wavetek 157, Programmable Waveform Synthesizer \$425
Wavetek 1855, CATV Sweep/Transmitter
Wavetek 288, Synthesized Function Generator, 20Hz-20MHz
(unused)
Wavetek 442, Dual HVLo Fitter, 1Hz-10KHz











 10-DAY RIGHT OF RETURN SATISFACTION GUARANTEED

## ECHFORUM

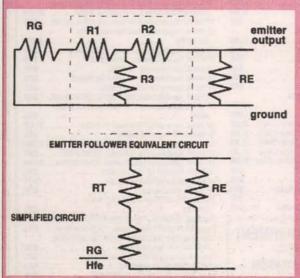
### ANSWERS TO #9999 - SEPT. 1999

I always thought that the output impedance of an emitter follower was the resistance of the emitter resistor.

I recently built a class A, two-stage single ended emitter follower transistor amplifier to provide a low Z output. Measurements reveal a lot lower impedance than the 100-ohm load resistor would lead me to believe. Am I missing something?

#1 - You are right. You are missing the internal resistance of the common collector transistor and its source resistance. In the equivalent circuit, I have called the source resistance RG and the external emitter resistor RE.

The resistors inside the dashed lines comprise the transistor equivalent



circuit. R1 is the base spreading resistance divided by the current gain. R2 is the emitter internal resistance and is inversely proportional to the emitter current. R3 is the collector resistance and is large enough to neglect.

These resistor values are hard to find and difficult to measure, but you can get a rough estimate with this equation: = R1 + R20.024/IE where IE is the current through RE.

The equation for the output resistance, for the simplified circuit is: Rout

= RE (RT + RG/Hfe) (RE + RT + RG/Hfe). or example, if RG = 10K, RE = 1K, IE = 10mA, and Hfe = 100, then Rout = 92.9 ohms. When you use this as the RG for the second stage, the final output is much lower.

> **Russell Kincaid** Milford, NH

#2 - The output impedance formula you cited is for a common emitter amplifier - not an emitter follower. A transistor essentially has two diode junctions in close proximity, and that tells you what the impedances are.

The collection-base junction is reverse-biased, so the collector looks like an open circuit. For small signal transistors, the collector impedance will be on the order of 200 kilohms. Consequently, the output impedance of a common emitter transistor will be set by the load resistor (which is much less than 200K).

The emitter-base junction is forward-biased, so the output impedance of the emitter looks like a conducting diode (i.e., almost a short). The small signal impedance of an emitter follower is the diode's dynamic impedance, [kT/q]/I.

At room temperature, [kT/q] is about 25mV. If the emitter current is 1mA, then the impedance looking into the emitter is 25mV/1mA = 25 ohms. If the emitter current is 10mA, then the impedance is 2.5 ohms.

Your cascaded emitter follower is probably running more than 10mA, and that is why the output impedance looks so small.

The base impedance would be the same as emitter impedance except that the current gain [beta] of the transistor comes into play. Because the collector junction is so close to the emitter, most of the emitter current is swept away by the collector.

The base current is about (1/beta) of the emitter current, so the base impedance is about beta times the emitter impedance. If beta is 100, then a 1mA emitter current implies a base impedance of 2,500 ohms.

The apparent output impedance of an amplifier can be lowered using negative feedback. Audio amplifiers often employ class B amplifiers with output impedances less than 0.1 ohms.

**Gerald Roylance** Mountain View, CA

#3 - Junction transistors have a parameter called the "Intrinsic Emitter Resistance" (Re). Re should be expressed with a lower case r, and read "r sub e," but subscripts don't usually survive the E-Mail process, so I will use Re.

The same comment applies to Hfe, Ro, Rs.

Let Ic = collector current, Hfe = Beta (common emitter current gain of the transistor); Rer = The emitter resistor resistance; Ro = Output resistance of the emitter follower (ignoring effect of Rer); Ro'= Output resistance of the emitter follower (including effect of Rer); and Rs = Source resistance of the signal source for the emitter follower.

For a silicon transistor: Re=25/Ic, with Ic expressed in mA, Re expressed in ohms.

Then Ro = Re + Rs/(Hfe+1) (ignores the contribution of the emitter resis-

Example: Hfe = 50 (Beta); Ic = 10 mA (Collector Current); Rer = 100 ohms (Emitter Resistor); and Rs = 1000 ohms (Source Resistance).

Ro = 25/10 + 1000/(50+1)

= 2.5 + 19.6 = 22.1 ohms

Ro appears in parallel with the emitter resistor Rer, so the net output

resistance is given by the parallel resistors formula:  $Ro' = 22.1 \times 100/(22.1 + 100)$ 

= 18.1 ohms.

As long as the emitter resistor is large compared to Ro, it has very little influence on the net output resistance Ro'. The major players are Ic, Hfe, and

For a two-stage emitter follower, the output resistance of the first stage would be the source resistance for the second stage.

Good beginner level coverage of the emitter follower can be found in Horowitz and Hill, The Art of Electronics, Cambridge University Press.

Jon Lark via Internet

one inch. If the pulley radius is 0.1 inch, then the motor can lift 200 ounces.

Gear trains can also change the weight a motor can lift. Gearing down allows you to lift more weight, but you cannot do it as fast.

There are limitations because gear trains have losses. Gear strength is also an issue. A friend of mine built a robot arm that was always breaking gear teeth. You should calculate the forces and torques throughout the drive train to avoid similar mistakes.

If your robot only moves on a hard, flat surface, then the motor only needs enough torque to overcome the friction in the drive train.

If you want the vehicle to accelerate quickly, then calculate Newton's F=mA to find the dynamic force the wheels must apply. From that, and the wheel radius, you can determine the required shaft torque to get the required acceleration.

If your robot will climb hills, then

the motor must also lift a fraction of the vehicle's weight.

**Gerald Roylance** Mountain View, CA

ANSWER TO #99910 & 99917 -SEPT. 1999

Fax: (360) 754-0825

Where can I get the plans to build a 6 VDC to 12 VDC converter to

### OCTOBER 1999 SUPER SPECIALS! THE DEST DATTEMES Mr. NiCd IN AMERICA I Packs & Charger for YAESU FT-50R / 40R / 10R: For ICOM IC-2SAT / W2A / 3SAT / 4SAT etc 7.2v 650mAh \$41.95 7.2v 1800mAh \$49.95 FNB-40xh sam-Name

FNB-47xh (NAME) FNB-41xh (5w MMH) 9.6v 1000mAh \$49.95 For YAESU FT-51R/41R/11R: FNB-38 pack (5W) 9.6V 700mAh \$39.95 For YAESU FT-530 / 416 / 816 / 76 / 26: FNB-26 pack (NEMP) 7.2v 1500mAh \$32.95 FNB-27s (5w NAM-9) 12.0v 1000m For YAESU FT-411/470/73/33/23: 12.0v 1000mAh \$45.95

FNB-11 pack (5w) 12.0v 600mAh \$24.95 6-Cell AA case FBA-10 \$14.95 Packs for ALINCO DJ-580 / 582 / 180 radios:

EBP-20ns pack 7.2v 1500mAh \$29.95 EBP-22nh pk.(5w) 12.0v 1000mAh \$36.95 EDH-11 6-Cell AA case \$14.95 For ICOM IC-21A / T22-42A / W31- 32A / T7A:

BP-173 pack (5w) 9.6v 700mAh \$49,95 For ICOM IC-W21A / 2GXAT / V21AT: (Black or Gray)

BP-180xh px (NAM-1) 7.2v 1000mAh \$39.95 BP-132s (5w NAM) 12.0v 1500mAh \$49.95 BP-83 pack 7,2v 600mAh \$23.95 For ICOM 02AT etc & Radio Shack HTX-202 / 404: 8.4v 1400mAh \$32.95 BP-8h pack BP-2025 pack (HTX-202) 7.2V 1400mAh \$29.95 For KENWOOD TH-79A / 42A / 22A: PB-32xh pack (NAMH) 6.0v 1000mAh \$29.95 PB-34xh pack (5w NMH) 9.6v 1000mAh \$39.95 For KENWOOD TH-78 / 48 / 28 / 27: PB-13 (original sizel) 7.2v 700mAh \$26.95 For KENWOOD TH-77, 75, 55, 46, 45, 26, 25: PB-6x (NAME), wichg plug() 7.2V 1200mAh \$34.95 Mail, phone, & Fax orders welcome! Pay with Mastercard / VISA / DISCOVER / American Express Call 608-831-3443 / Fax 608-831-1082 Mr. NiCd - E. H. Yost & Company 2211-D Parview Road, Middleton, WI 53562 CALL OR WRITE FOR OUR FREE CATALOGI

Cellular / Laptop / Videocam / Commercial & Aviat E-mail: ehyost@midplains.net

## SOLUTIONS TO YOUR CABLING NEEDS

Cat.5 -- Enhanced Cat.5 -- USB -- IEEE1284 / 488 / 1394 Firewire -- High-End Monitor -- Manual & Auto Switches Apple -- Custom Cables -- Premise Wiring -- more! **HUGE SELECTION OF SCSI CABLES & ADAPTERS** 

## CPU COOLERS ARE HERE FOR MOST POPULAR PROCESSORS!

(DEEP DISCOUNTS FOR VOLUME PURCHASES)

Order Online 24 hrs./day. Reseller & Qty. Discounts Available! No minimum order, same day shipping on most orders, A+ and CET technician available to answer your questions



Northwest Cable & Connector Co. www.nwcable.com



Phone: (360) 754-3606

install a new radio into an old six-volt.

From the J.C. Whitney catalog #630J, page 137: A 6-12 volt converter designed specifically to supply juice to an auto radio is available from Custom Autosound. They've even got a toll-free number: 1-800-88TUNES 10:30a.m-7:30p.m. cen-

You need to tell them whether the car with the six-volt system has a negative or a positive ground. It will cost you about \$89.00. It's rated at seven amps. You don't order it from J.C. Whitney; they just tell you where to find it.

> **Jack Dennon** Warrenton, OR

### ANSWER TO #99911 - SEPT. 1999

I am a university student currently doing a project involving the MC68HC811E2FN52PLCC. I can't find the microcontroller in my country (Malaysia).

Can someone help?

The Motorola MC68HC811E2 is a common, general-purpose microcontroller. Information on the part can be found at: http://mot-sps .com/products/microcontrollers /8\_bit/m68hc11\_family/68hc811 e2.html

Features of this part include 512 bytes RAM, 2KB EEPROM, SCI/SPI ports, eight-channel, eightbit A/D, 16-bit timer, 38 general-purpose I/O. The part should be available from most distribution channels, as well as direct from Motorola.

The device in question is supplied in a 52-pin PLCC package.

The Motorola Distributor Contacts web page http://motsps.com/support/sales/ gives the following distributors in or near Malaysia:

Ultro Technologies Pte. Ltd 47 Loyang Dr. Singapore 1750

Tel: (65) 545-7811 or 540-8328 Fax: (65) 545-6120 or 545-

### **Arrow Components**

(M) Sdn Bhd Suite 18.01 Menara PSCI 39 Jalan Sultan Ahmad Shah 10050 Penang Malaysia

Tel: (604) 229-6613 Fax: (604) 229-6623 Web: www.arrowasia.com

### **Future Electronics**

51-19-F1 Menara BHL Bank 51, Jalan Sultan Ahmad Shah Penang 10050

Tel: [60-4] 227-7213 Fax: (60-4) 227-7263 Web: http://www.future.ca

Joe Grand via Internet

### ANSWERS TO #9994 - SEPT. 1999

Note - The remaining answers all pertain to question #9994.

I have an engineering calculations program "ECALC" written in IBM BASICA. It will not run in Windows or even in DOS on the new Pentium processor computers.

# Go Wireless With Our Modules

### SILRX/TXM

SILRX - \$26.00 ea. TXM - \$15.50 ea.

The TXM and SILRX modules are a transmitter and receiver pair which can achieve a way radio data link-up to a distance of 200m

way tatio data link-up to a distance of zoom over open ground.

Both units are supplied in space-saving sin-gle-in-line packages and offer SAW controlled, wide band FM transmission/reception.

The modules are particularly suited to bat-

The RPC module is an intelligent transceiv-which enables a radio network link to be sim-implemented between a number of digital rices. The module combines an RF circuit

intensive low-level packet format-

recovery func-tionality, requiring only a simple

antenna and 5V supply to operate with a

microcon-troller or a PC

RPC

RPC - \$99.00 ea.

tery-powered, portable applica-tions where low power and small size are critical design criteria.

### TX2/RX2

TX2 - \$19.50 ea. RX2 - \$38.50 ea.

The TX2 and RX2 radio transmitter a

use in portable, battery

900 MHz AVAILABLE NOW

BiM - \$69.00 ea. The BiM module integrates a low-power UHF FM transmitter and matching superhet receiver together with data recovery and

solution to imple menting a tional short range

radio data



## Lemos International Co., Inc.

link

65 Southbridge Street, Auburn, MA 01501 Phone (508) 798-5004 ♦ Fax (508) 798-4782 www.lemosint.com ♦ sales@lemosint.com All products available in either 418 or 433 MHz

Write in 80 on Reader Service Card.

How can I get IBM BASICA to run on a Windows machine?

There are three approaches to the problem of running a program that requires BASIC A on a modern PC. I will describe them, starting from the simplest and moving to the more complex.

Continued on page 77

### ANSWER TO #8994 - AUG. 1999

I need a circuit to cycle up to a 1 hp 120 VAC motor, at any off/on (continuous) interval (selectable in five minute increments) up to 60 minutes. (Same time off as on.)

The timing intervals of N x 300 seconds (five minutes) for N = 1 to 12,

may be obtained with the following circuit.

U1 is a SPG6851B from Epson America (Digi-Key SE3104-ND). This programmable crystal oscillator has 57 different output frequencies. As shown in the schematic, the control inputs of the SPG8651B will provide the timing you need.

I have shown S1 and S3 to illustrate how you may change the timing. You may switch all six control inputs of the device to obtain a wide

range of timing, if required.

The output of U1 is divided by U2 (CD4040B) and the four-bit binary count is presented to U3 (CD4585B) where it is compared to a binary value selected by S2. Each time the values match, RLY1 will change states from off to on and then on to off (with a 50% duty cycle). S2 must be constructed so that decimal values from 1 to 12 in binary are presented to U3.

It is important not to present all zeros to U3, and therefore you will need to construct the binary codes required from a 12 position, four-pole

rotary switch

Binary 0001 = five minutes on, five minutes off. Binary 1100 = 60 minutes on, 60 minutes off. U4 (CD4013B) will reset the count of U2 and toggle Relay RLY1. The circuit essentially counts from one five minute period to 12 five minute periods continuously.

For testing, you may program U1 for faster times by adding switches to the six control lines per the data sheet for the SPG8651B. All resis-

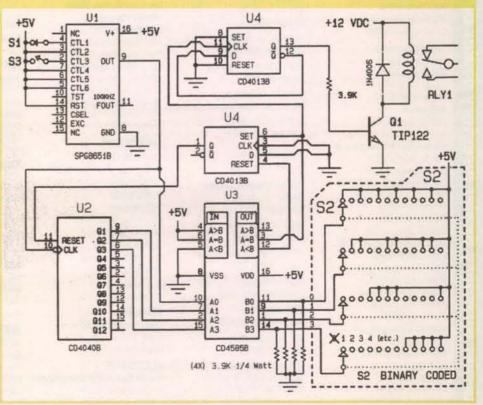
tors are 1/4 watt 3.9K ohm.

To control a 1 HP 120 VAC motor with the circuit, you will need to connect a large power relay such as Newark part number 93F7669 between RLY1 and your 1 HP motor.

RLY1 will require 1 amp 120 VAC contacts, which will operate the coil of the large power relay. If you do not want to build a circuit, you may purchase a recycling timer in the configuration you seek.

Grainger sells several from Omron described as universal timers. Again, you should operate the coil of a larger power relay and control the 1 HP motor with the larger contacts of the power relay, because the timer contacts are not rated for 1 HP.

David R. Howland Aptos, CA



The dealers listed below carry the latest issue of Nuts & Volts, for your convenience.

### ALARAMA

Little Professor Book Center Birmingham 35209

RT Systems Amateur Radio Supply

8207 Stephanie D Huntsville 35802

### ARIZONA

**Batteries Plus #330** 3014 N. Dobso

**Batteries Plus #334** 1155 S. Power Rd. #108

Meso 85206

**Batteries Plus #331** 2404 F Bell Rd

**Batteries Plus #332** 

directory dealer directory dealer directory dealer

3415 W. Glendale Ave. Ste. 4

**Batteries Plus #333** 

1829 E. Southern Ave emne 85282

Elliott Electronic Supply

1251 S. Tyndall Ave

642 E. 39th Pl. Ste. 5 Yuma 85365

**Tower Records** 

Tempe 85281

### **AUSTRALIA**

P.O. Box 595

29 Ellesmere Cres Tullamarine 3043

### www.dontronics.com CALIFORNIA

### **Abletronics**

9155 Archibald Ave. Unit E Cucamonga 91730

Advanced Computer Products, Inc.

1310 "B" E. Edinger Ave. Santa Ana 92705

All Electronics

905 S. Vermont Ave Los Angeles 90006

14928 Oxnard St

Allen's To Go

Lockeford 95237

Son Jose 95131 Centerfold International

716 N. Fairfax Ave os Angeles 90046

Del Amo Books & News

3758 Sepulveda Blvd.

Electro Mavin

2985 E. Harcourt St. Rancho Dominguez 90221

**Ford Electronics** 

8431 Commonwealth Ave Buena Park 90621

**Harding Way News** 

Stockton 95204

Harold's Newsstand 524 Geary St

San Francisco 94102

**HSC Electronic Supply** 4837 Amber Ln Sacramento 95841

3500 Ryder St. Santa Clara 95051

5681 Redwood Dr

**Hyatt Electronic Surplus** 371 N. Johnson Ave El Cajon 92020

JK Electronics 6395 Westminster Ave

Studio City 91604 Len's Electronic Parts

14410 F. Valley Blvd. Industry 91746 Len's Electronic Parts

108 W. 25th St. #D National City 91950 Lion Electronic Labs

4948 E. Townsend Ave. Fresno 93727

7207 Arlington Ave. Ste. G

**Op Amp Technical Books** 1033 N. Sycamore Ave

Los Angeles 90038 **Panorama Electronics** 

8761 Van Nuys Blvd. Panorama City 91402

Supply, Inc. 20655 Soledad Cyn. Rd. #15 Say-On Flectronics

13225 Harbor Blvd. Sierra Madre Newsstand

55 N. Baldwin Ave Sierra Madre 91024

Bieber 96009 Tower Books

211 Main St Chico 95928

7840 Macy Plaza Dr. Citrus Heights 95610

1280 E. Willow Pass Rd. Concord 94520

630 San Antonio Rd Mountain View 94040

1600 Broadway Sacramento 95818

Sacramento 95821

Tower Records/Video

220 N. Beach Blvd Angheim 92801

5703 Christie Ave. Emeryville 94608

6310 F. Pacific Coast Hwy Long Beach 90803

3205 20th Ave. San Francisco 94132

2525 Jones St. San Francisco 94133

871 Blossom Hill Rd San Jose 95123

**Video Electronics** 3829 University Ave. San Diego 92105

### CANADA

**ACE Electronics** 501 Linwell Rd St. Catherines, ON L2M 2R2

Com-West Radio Systems Ltd

8206 Ontario St. #100 Vancouver, BC V5X 3E3

Emma Marion Ltd 2677 E. Hastings St Vancouver, BC V5K 1Z5

Muir Communications Ltd. Victoria BC V87 3K6

### COLORADO

Tower Records/Video 2500 E. 1st Ave.

Denver 80206 CONNECTICUT

**Archway News** 64 Bank St New Milford 06776

**Electronic Service Products** 437 Washington Ave.

### North Haven 06473 DELAWARE

**Newark Newsstand** 70 E. Main St Newark 1971

### DISTRICT OF COLUMBIA

**Tower Records** 2000 Pennsylvania Ave Washington 20006

### FLORIDA

Alfa Electronic Supply 1502 S. St. Rd. #7 Hollywood 33023

Al's News 8219 S.W. 124th St.

Migmi 33156 Astro Too 2854 Samo Rd

Melbourne 32935 Clarks Out of Town News

303 S. Andrews Ave Fort Lauderdale 33301

Mike's Electronic Distributing Co.

1001 N.W. 52nd St Fort Lauderdale 33309 Skycraft Parts & Surplus, Inc.

2245 W. Fairbanks Winter Park 32789 Sunny's At Sunset, Inc.

8260 Sunset Strip

GEORGIA **Tower Records** 

3400 Around Lenox Dr. N.E.

### HAWAII

SolarWorks! 525 Lotus Blossom Ln.

Ocean View 96737 Tower Records 4211 Wajalae Ave Honolulu 96816

611 Keeaumoku Honolulu 96814

### MAHO The Current Source

5159 Glenwood Boise 83714

### ILLINOIS

Tower Records/Video/Books 383 W. Army Trail Rd.

Bloomingdale 60108 2301 N. Clark St. #200 Chicago 60614

1209 E. Golf Rd Schaumburg 60173

### INDIANA

Harbourtown Sales 108 Park 32 W. Dr Noblesville 46060

### KANSAS

Hollywood At Home 9063 Metcalf Ave. Overland Park 66212

Lloyd's Radio & Electronic, Inc. 220 W. Harry St Wichita 67213

### LOUISIANA

**Lakeside News** Metairie 70002

### MARYLAND

Tower Records/Video 2566 Solomons Island Rd. Annapolis 21401 1601 Rockville Pike #210

### Rockville 20852 MASSACHUSETTS

Newsbreak, Inc. 579 G.A.R. Hwy. Rt. 6 Swansea 02777

### MICHIGAN

Little Professors Book Center 22174 Michigan Ave. Dearborn 48124

Purchase Radio Supply, Inc. 327 E. Hoover Ave. Ann Arbor 48104

### MINNESOTA

Radio City, Inc. 2633 County Road 1 Mounds View 55112

### MISSOURI

Accurate Instruments 11201 E. 24 Hwy. Independence 64054 **Electronics Exchange** 

8644 St. Charles Rock Rd.

### St. Louis 63114

NEVADA **Amateur Electronic Supply** 1072 N. Rancho Dr. Las Vegas 89106

Less Buster's Electronics 2930 N. Las Vegas Blvd. North Las Vegas 89030

Radio World 1656 Nevada Hwy Boulder City 89005

Tower Records/Video 4580 W. Sahara Ave. Las Vegas 89102 6450 S. Virginia

### Reno 89511 **NEW JERSEY** Tech-Systems

Electronics, Inc 1309 Hwy. 71

### **NEW YORK**

All Phase Video Security, Inc. 70 Cain Dr Brentwood 11717

Computer Warehouse

137 E. Bridge St.

Ham Central 3 Neptune Rd.

Poughkeepsie 12601 Hirsch Sales Corporation 219 California Dr

Williamsville 1422 Tower Records/Video 105 Old Country Rd

Carle Place 11514 350-370 Route 110 Huntington 11746

1961 Broadway New York 10023 383 Lafayette St.

### New York 10003 OHIO

Compustuff 241 Great Oaks Trl. Wadsworth 44281

**Footsteps** 4925 Jackman Rd. Store #58 Toledo 43613

Hosfelf Electronics, Inc. 2700 Sunset Blvd Steubenville 43952 Keyways, Inc.

Miamisbura 45342 Leo's Book Shop 333 N. Superior St.

204 S. 3rd St.

Toledo 43604 Powermaxx, Inc. 1587 U.S. Route 68 N.

### Xenia 45385 OKLAHOMA

Steve's Books & Magazines 2612 S. Harvard Tulsa 74114 **Taylor News & Books** 133 W. Main, Ste. 102

### Oklahoma City 73102 OREGON

News & Smokes 2295 W. Main St. Medford 97501

News & Smokes #8 259-C Barnett Rd. Medford 97501 **Norvac Electronics** 

7940 S.W. Nimbus Ave. Bldg. 8

Beaverton 97005 960 Conger Eugene 97402

1545 N. Commercial N.E. Salem 97303

**Powell's Technical Bookstore** 33 N.W. Park Portland 97209 **Tower Books** 

1307 N.E. 102nd Ave. Portland 97220

Bedford St. News 308 Bedford St Johnstown 15901 Lehman Scientific 2997 F. Cape Horn Rd

PENNSYLVANIA

**Tower Books** 425 South St. Philadelphia 19147 **Tower Records** 

340 W. Dekalb Pike

Red Lion 17356

King of Prussia 19406

555 Electronics 5646 Farrow Rd. Columbia 29203

### **TENNESSEE**

**Tower Books** 2404 W. End Ave Nashville 37203

### TEXAS

BDL News, Inc. 809 Pierce Houston 77002 **Electronic Parts Outlet** 

3753-B Fondren Rd Houston 77063

Mouser Flectronics 958 N. Main St Mansfield 76063 **Tanner Electronics** 1301 W. Bettline #105

### Carrollton 75006 Tower Records 2403 Guadalupe St. Austin 78705

Richmond 23220

Richmond 23230

VIRGINIA American Computer Clearance 1609 Rhoadmiller St.

Tower Records/Video/Books 4110 W. Ox Rd. #12124 Fairfax 22033 1601 Willow Lawn Dr.

### 8389 E. Leesburg Pike Vienna 22182

WASHINGTON A-B-C Communications,

17541 15th Ave. N.E. Seattle 98155 **Bohica Concepts** 

214 2nd St Morton 98356 Cody Books Ltd.

1125 Fir Ave Blaine 98230

Emma Marion Ltd. 1574 Gulf Rd. Point Roberts, 98281 Service Request

Spokane 99205 Supertronix 16550 W. Valley Hwy Seattle 98188

3304 W. Rowan Ave

Tower Books 10635 N.F. 8th St Bellevue 98004 20 Mercer St.

### Seattle 98109 WISCONSIN

**Amateur Electronic** Supply, Inc. 5710 W. Good Hope Rd. Milwaukee 53223

Greenfield News & Hobby 6815 W. Layton Ave Greenfield 53220 Cudahy News & Hobby Ctr.

### 4758 Packard Ave. Cudahy 53110 WYOMING

Western Test Systems 2701 Westland Ct. #B Cheyenne 82001

**SOUTH CAROLINA** 

# Servos, Steppers, and Optical Encoders — Part 3

by TJ Byers

Which one works best in your robotic or R/C project? Here's everything you need to know. This month: Bipolar stepper motor electronic controllers.

with robots, model planes, or boats, there are motors inside which supply the muscles and habits that make them go. Choosing the right motor for your project, though, can be a daunting experience. Motors that provide locomotion aren't the same as those that move robotic arms or pilot a plane.

Basically, controller motors come in three flavors: servos, steppers, and encoders. Last month, we looked at the construction of bipolar stepper motors. In that article, you discovered that there are three methods used to make them spin, along with the pros and cons of each. This month, I show you the electronics that drive bipolar stepper motors.

#### Bipolar Stepper Motor Drivers

Bipolar stepper motors present a dilemma because of the design trade-offs. On one hand, the motor is simpler to construct and more versatile than the unipolar stepper because it has only two windings (the unipolar has four). On the other hand, the drive circuitry needed to reverse the polarity of the coils is more complex. Until the advent of high-power integrated circuits, this was a real deterrent because the part count is high and costly.

The key to bipolar stepper motor operation is an H-bridge, which is basically two op-amps or push-pull circuits wired in a bridge circuit (Figure 1). When the output of one op amp is high, the other is

low. This circuit is found in many applications, including audio amplifiers and DC motor controllers. For complete bipolar motor control you need two H-bridges — one for each stator winding.

The schematic in Figure 2 shows a typical H-bridge driver for a bipolar stepper motor, made with just four NPN transistors, that can power small stepper motors with current ratings up to 800 mA. For motors that require more current, the 2N2222A transistors can be replaced with more powerful ones, like the TIP31 or 2N3055. However, you may need to make adjustments in the value of the 1k resistors if the gain (hFE) of the replacement transistors is below 150.

While the circuit looks complicated, it's easy to follow how it works.

Before I begin, you must realize that the respective coil inputs can't be high simultaneously. That is, coil A1 and coil A2 inputs can't be high at the same time, but it's okay for them to be low at the same time. (This is a logical state and has nothing to do with possible Vs to GND shorts.) Also, this discussion applies to the A coil only, but the B coil operation is identical, so there's no reason to repeat

At rest, with no inputs

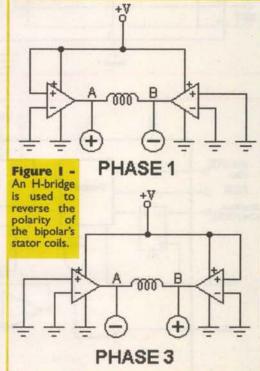
to coil A1 or coil A2, both the X and Y leads of the stator winding are connected to V+, hence, no current flows through the coil. Now if the coil A1 input goes high, it turns on Q2, which shorts the base of Q1 to ground, which turns Q1 off. This action also connects the X stator lead to ground, which causes current to flow through the winding. Now let's

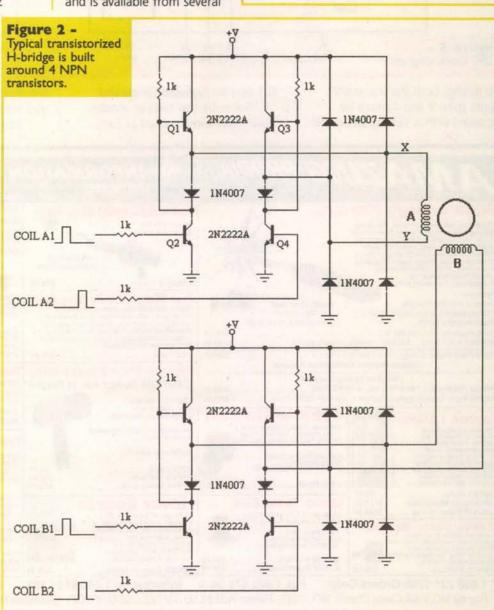
make the coil A2 input high and toggle coil A1 low. This turns off Q2 and causes Q4 to conduct current and shut off Q3 which, in turn, grounds the Y lead and forces the X lead high. Voila, we have polarity reversal.

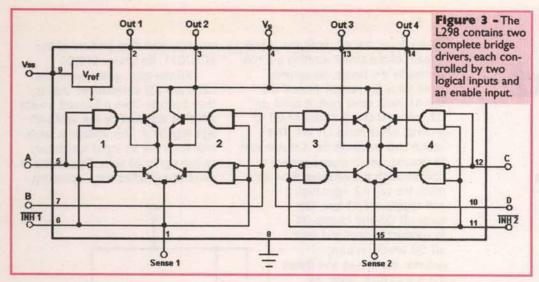
While this is a perfectly good design, a simpler solution is to use an integrated circuit H-bridge driver specifically designed for stepper motor applications, like the L298 from STMicro-electronics (781-259-0300; http:// www.st.com). This 15-pin IC contains two complete bridge drivers (Figure 3), each controlled by two logical inputs identical to those used in the transistor controller in Figure 2 and an enable input. This chip is capable of supplying up to two amps of drive current, and is available from several

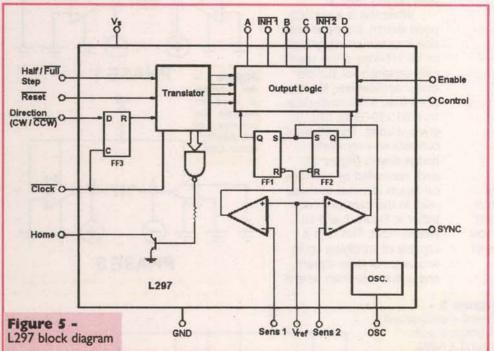
sources, including jobbers of the ECG7071, for under \$10.00.

All the logic gates inside the L298 are TTL compatible; that is, they operate from a five-volt source which is supplied by the Vref voltage regulator. This voltage is separate from the Vs input which can switch up to 40 volts. To prevent switching glitches from upsetting









the timing, both the Vss and Vs inputs (pins 9 and 4) must be bypassed with a 1uF tantalum and 0.1 ceramic capacitor in parallel. Some bipolar stepper motors have eight wires instead of four,

which are connected to four internal coils. These coils can be wired in parallel to produce more torque or in series to reduce the current (at the expense of torque).

#### **Bipolar** Stepper Motor Controllers

Now that we have the brawn, we need a brain - which is called

a stepper motor controller. While the L298 can be connected to any stepper motor controller - including a BASIC Stamp or PIC microcontroller - the logical match-up is an L297 -L298's companion chip.

The controller circuit that drives the push-pull transistors of the H-bridge is a digital sequencer, which basically converts a clock input into a proper sequence of events, like that shown in Figure 4.

This sequence is for the popular two-phase operating mode where both coils are energized at the same time. This mode provides the most torque and is the simplest timing sequence to generate. That's why it's often called the normal mode, and

the mode used for the torque specs you see in catalogs.

Inside the L297 (Figure 5) are

three major elements. The most critical is the translator circuit. It's in this circuit that the clock pulses are forced into the stator coil sequence needed to rotate the stepper motor in its various modes. The stepper motor operating mode is determined by three input pins.

The HALF/FULL STEP input selects between the full wave/two phase and half step modes. Notice that the full wave and two phase modes are selected using a logic low.

The difference between them is the state of the translator at the time this pin is pulled low. If the translator is in the even mode, it generates a full wave pulse sequence; in the odd mode it generates a two phase sequence. The reset input can be used to initialize the translator in the even mode, and the home output is used to indicate the translator's current state. The direction input determines the direction of rotation and the clock input sets the rotational speed.

#### Overdriving Stator Windings With High Voltage

The output of the translator goes to the output logic circuit, which drives the input of the Hbridge. The output of the output logic can be further controlled using the on-board PWM (pulse-width modulator). What this circuit does is control the amount of current flowing through the stator windings.

You see, coils are inductors and it takes time for the current to build up to full power - just like it takes time for the voltage across a capacitor to come up to full voltage. You can speed up the process by applying a larger than rated voltage across the winding. In fact, many stepper motor manufacturers recommend driving 12-volt steppers from a 36-volt source. The trick is to remove the voltage before the current exceeds the coil's maximum current rating. This is where the PWM circuit comes in.

There are two pins on the L297 called SENSE1 and SENSE2. These inputs sense the current through their respective stator winding by measuring the voltage drop across a resistor to ground and comparing it to a reference voltage (Vref). These resistors are located on pins 1 and 15 of the L298 H-bridge chip.

Essentially, it's a return path for the bottom emitter of the H-bridge to ground. When the voltage drop across the SENSE resistor equals the reference voltage, a flip-flop triggers and interrupts the output logic driver until the next PWM clock pulse arrives. This OSC clock pulse is generated internally and has no relationship to the clock input pulse that controls the rotational speed of the



stepper motor. Think of it as a switching voltage regulator in that the chopper frequency is way faster than the current it's controlling.

Using this method, the stepper motor can achieve higher speeds and greater torque without exceeding the current rating of the coils.

Be aware, though, that this feature is built into the L298 - a feature not all H-bridges support. The 2N2222A H-bride in Figure 2, for example, doesn't have current sense. When not using the PWM, it has to be turned off by grounding the SENSE pins and connecting Vref

#### **Finished Bipolar** Controller

Now that you know how the L297 and 298 work, here's how to make them work together (Figure 6). This bipolar stepper motor circuit will drive any bipolar motor up to two amps. The typical upper step rate is 25 kHz- about 12,000 stepsper-second in the two-phase mode. At 400 steps (0.9 degrees/step) per revolution, that calculates to be 1800 RPM; at 7.5 degrees per step, it's 15,000 RPM. There's nothing new that we haven't already talked about in this perfect match-up of L297 to L298, so you won't find any surprises here. But here are some things you need to know about if you want to duplicate this circuit.

The recovery diodes are very important because they prevent the back EMF from the collapsing field of the stator winding from burning out the H-bridge transistors. Notice that the damper diodes are also a critical part of the 2N2222A H-bridge - for the same reason. But because of the switching speed of the L297 (up to 40 kHz at times), you need very fast recovery diodes — something on the order of 200 nS or less at 2A. A 1N4007 won't cut it.

Individually, these fast-recovery diodes cost about a buck apiece, and you need eight of them. However, you can buy an L6210 or UC2610 - which has eight of these diodes in one IC package - for under \$5.00. Whichever way you go, just make sure the diodes are in place before you apply power or you can kiss your L298 good-bye.

Next on the agenda is the control interface. No doubt those of our readers familar with microcontrollers know just what to do, and they can have at it. But there are still a lot of us who are comfortable with flipping switches rather than data bits. With that in mind, I've taken the liberty to present this design in a more elementary, hardware level.

For example, a single toggle switch reverses the direction of the motor and a 555 timer pulse generator adjusts the stepper rate. So

now you have speed and direction control with nothing more than a potentiometer and a switch - no software needed. The mode inputs are also hard-wired for half-step mode, which provides high resolution and good torque. It may not be the most versatile bipolar controller, but it works just fine for many hobby applications.

The two variables in this design are the clock rate from the 555

pulse generator and the Vref voltage of the PWM. Fortunately, both are easily calculated. Let's start with the PWM controller.

Let's say that your stepper motor draws one amp of current, and that the sense resistors are 0.5 ohms, as the schematic shows. Using Ohm's Law, 1 amp across 0.5 ohms generates 0.5 volts Figure 4 - This is the timing sequence for the popular Two-Phase (Normal) bipolar operating mode.

TWO-PHASE STEP BIPOLAR STEPPER TIMING

( $E = IR = 1 \times 0.5$ ). This means the Vref



QUALITY **PARTS** 

FAST SHIPPING

DISCOUNT PRICING

CALL, WRITE, FAX or E-MAIL For A Free 96 Page CATALOG.

Outside the U.S.A. send \$3.00 postage.

#### Touchtone Keypad

Farbell# DU200P (A) keypad with touchtone (DTMF) circuitry. Field replacement for some GTE payphones. White plastic buttons with black numerals and letters. 11 color-coded leads, 9" long with spade lugs.

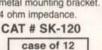
**CAT # KP-11** 

25 for \$75.00

\$400 each

#### 5" Paging Horn

Metal 5" horn speaker for P.A. applications. 5.25" diameter bell X 6" long. Adjustable metal mounting bracket. 4 ohm impedance



for \$60.00

#### Silent Footswitch

Control International, Inc Quality, heavy-guage metal footswitch designed for silent operation. S.P.S.T., normally-open, rated 11 Amps @ 250 Vac No-slip rubber pad on top surface. 3' cable. 2 conductor 16 AWG, stranded wire. 3.56" X 2.73" X 1.36" high

\$550 each CAT # FSW-9

3000 MCD ULTRA-BRIGHT RED LED

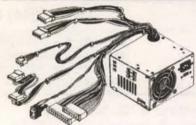
Everlight # 383URC-2/TR1-C(R) Red, "Ultra-bright" T 1 3/4 LEDs Tape-and-reel" parts. These are 5 mm diameter water-clear LEDs that light bright red at 20 ma. CAT# LED-50



2 for \$100

100 for \$35.00 1000 for \$250.00

#### REDUCED PRICE! 185 Watt Power Supply

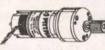


Compaq # 172417-002 (172432-001) Input: 120/240 Vac (switchable) DC outputs: +5V @ 18A, +3.4V @ 12A, +12V @ 6A. -5V @ 0.15A.-12V @ 0.15A Size: 6.5" x 5.75" x 3.85" Built-in fan. On/off switch on 20" lead. Power cord not included. UL CSA

**CAT # PS-185** 

#### 40 RPM Gearhead Motor

Pittman # GM8212C127-R2. Small, powerful gearhead motor.



187:1 ratio. No load specs: 40 RPM @ 19.1 Vdc, 130 mA. 24 RPM @ 12 Vdc, 160 mA. Overall dimensions 3" long X 1.37" diameter 0.185" (3/16") diameter X 0.75" long shaft. A brass 0.56" diameter gear with 16 cogs is fas-tened to the shaft. 17" leads.

CAT# DCM-135

1500 each 10 for \$125.00

#### S-VHS Video Tapes (Used)

Super VHS tape users! Save a bundle on namebrand S-VHS, T-120 tapes. These tapes were used for a brief period. then bulk erased. The record-protect tabs have been broken out, so you will have to cover the notch with a piece of tape, \$300 but they work great

CAT # S-VHS

10 for \$28.00 • 100 for \$250.00

#### 20 Character X 4 Line LCD

Optrex # DMC 20434-CEM (PWB 20434-CEM) 5 x 8 dot format. 3" x 1" viewing area. 3.88" x 2.38" module. Removed from new

equipment. May have felt padding on metal bezel. 14 pin single row header is pre-attached Spec/hook-up sheet included. \$700 each

CAT# LCD-46 10 for \$60.00

#### Snap-In Capacitor

560 UF 400 Vdc - NICHICON CE 85° C LQ (M). 1.39" dia. X 1.83"h 0.4" lead sp. CAT# EC-5640

10 for \$3.75 each 100 for \$3.00 each

\$400 each

#### AIWA "Surround" **Bookshelf Speakers**





AIWA# SX-ANA72.

Great sounding, great-looking set of AIWA "Front 180" bookshelf speakers with a unique "expanded imaging" feature. Uses an array of speakers and ports to project the sound for-ward and toward the center at a 45 degree angle to create an expanded stereo listening area and the impression of a "center-channel." Each speaker has two channels with two separate input cables. The AIWA stereo system for which they were designed had separate outputs for the center-projecting part of each speaker, but the center-angled speakers sound good when connected in parallel with the front-facing channel. Titan silver and charcoal. Removable front grills. 9.75" wide X 11" deep X 12.25"

**CAT # SK-72** 

\$4995 per pair

#### ORDER TOLL FREE

MAIL ORDERS TO:

ALL ELECTRONICS CORP.

P.O. BOX 567

VAN NUYS, CA 91408-0567

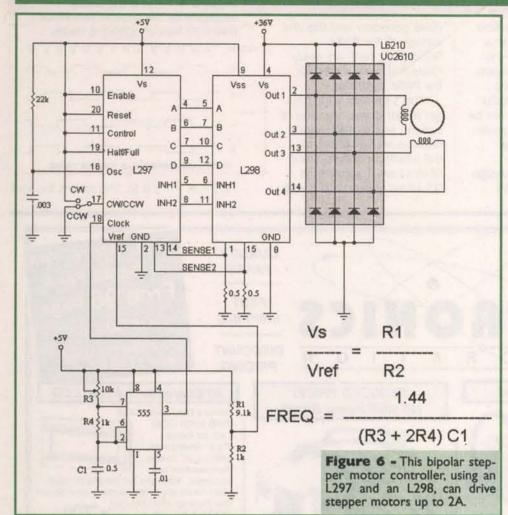
FAX (818) 781-2653 • INFO (818) 904-0524 SHOP ON-LINE www.allelectronics.com E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D • Shipping and Handling \$5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice



VISA

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

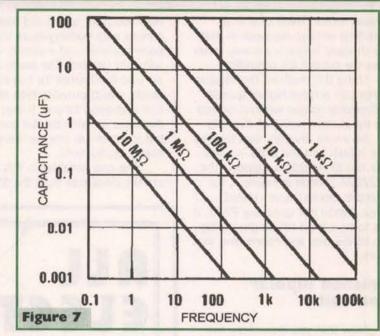


voltage should be 0.5 volts for a one-amp stepper motor. This reference voltage can be generated using a simple resistance divider. The formula is:

$$\frac{\text{Vs}}{\text{Vref}} = \frac{\text{R1}}{\text{R2}}$$

Let's say R2 is 1k, then, using Ohm's Law again, we need a current of 5 mA to generate 0.5 volts across R2. To generate a current of 5 mA from a 5-volt source, the total resistance is 10k. Subtracting 1k from 10k gives us a value of 9k for R1; the standard value is 9.1k, which is close enough. For 2 amps, the Vref voltage is 1 volt.

Given the above scenario, that means R1 equals 8k and R2 is 2k. Just keep in mind that this is a ratiometric function. As the value of R2 increases, R1 decreases by the same amount. Personally, I'd place a 1N4001 diode from Vref to ground (anode up) and a 1k resistor from Vref to Vs. That stabilizes Vref at 0.7 volts, which should serve most 1A



through 2A steppers.

On to the stepper rate, which is a function of the clock pulse frequency. For the sake of argument, let's say the stepper motor moves in 15-degree increments. That means it takes 24 steps to complete one revolution. In the half-step mode, that number becomes 48 steps per revolution. In the half-

step mode, one clock pulse equals one step. So, if you want to spin the motor at 1,000 RMP, you need to generate 48,000 pulses. Divided into seconds, the number is 800 — or 800 Hz. The math is

$$FREQ = \frac{RPM \times STEPS \text{ per REV}}{60}$$

The next question is, what value of C1 does it take to generate 800 pulses a second?

Here's that formula.

FREQ = 
$$\frac{1.44}{(R3 + 2R4) C1}$$

In our example, the values are: R3 = 5k, R4 = 1k, and C1 = 0.5uF. Of course, moving the wiper of the potentiometer from its mid-position of 5k (10k being total) will speed up and slow down the motor. But isn't that what we wanted? Adjust the values of C1 and R3 to fit your needs; leave R4 alone. Here's a nomograph that does the math for you (Figure 7).

#### One More To Come

For those readers who have suffered through this series on servos and steppers, rest assured there's just one more installment to come. It will deal with the unipolar and variable reluctance stepper motors, and touch briefly on encoders. So 'til next time, get those bipolars spinning. **NV** 

#### Converters \* Remotes \* Converters \* Remotes Converters Remotes **Modern Communication** (405)691-0594 TEL & FAX Converters: 50 100 Parts, Parts, Parts Panasonic: TZPC-175 . . . . . \$49.00 \$45.00 \$39.00 Panasonic: TZPC-145 . . . . . . \$45.00 \$39.00 \$35.00 Centurion CF-3000 (NEW) 50+ 100+ 10+

True 99 Channel . . . . . . . . \$65.00 \$60.00 \$55.00 Regal: CR-83 .....\$39.00 \$35.00 \$32.00 Remotes: Jerrold: 400, 450, 550 ......\$4.50 \$4.00 \$3.75 CFT: 2XXX ... . . . . . . . . . . . . . . \$4.95 \$4.50 \$4.25 \$4.25 S/A: 175, 475 . . . . . . . . . . . . . . . . . \$4.95 \$4.50 S/A: 8600 Display ......\$4.95 \$4.50 \$4.25 Panasonic: 170, 175 ......\$4.95 \$4.50 \$4.25 \$4.25 Zenith (ALL) .....\$4.95 \$4.50 Pioneer (ALL) ......\$4.95 \$4.50 \$4.25 Tocom 5503-VIP . . . . . . . . . \$4.95 \$4.50 \$4.25 \$5.50 \$5.25



PIC16C622 \$3.15 \$2.95 \$2.75 PIC16C54RC/P \$2.15 \$1.95 \$1.75 PIC16C56RC/P \$2.15 \$1.95 \$1.75 Micro 68H705C8P \$6.50 \$6.15 \$5.95 4 MHz (Resonator 2 pins) \$0.45 \$0.40 \$0.35 \$0.45 \$0.40 \$0.35 4 MHz (3 pins) Crystal: 117, 119 \$3.75 \$3.50 \$3.25 18 pin IC Socket \$0.15 \$0.12 \$0.10 Toggle Switch on/on \$0.95 \$0.85 \$0.75 **Call for Larger Quantity Quotes** 

Converters \* Remotes \* Converters \* Remotes \* Converters \* Remotes

# TECHFORUM

Continued from page 71

1. You can install an alternative BASIC to BASIC A. Get the free "BWBASIC" (Bywater BASIC, a clone of GWBASIC) from ftp://oak.oak-land.edu/pub/unix-c/languages/basic/basic.tarz.

You will need a C compiler to build this, or else get someone else to do this for you. See if this version of BASIC will work with the program either under Windows or in DOS.

2. Consider the possibility that it is the DOS that ships with Windows 9X, MS DOS 7, that is incompatible with BASIC A, rather than the Pentium processor.

Proceeding on that assumption, partition your hard drive. You will need a program such as Partition Magic to do this or you can start over from scratch by wiping your hard drive, creating two partitions, and reinstalling Windows on the first one.

In either case, you will install an alternative DOS version on the second partition. Free DOS from http://www.freedos.org will cost you nothing. Now install BASIC A on that partition and try loading your program.

 Rewrite the program in VB or VC. If you lack the programming skills to do this, get an aspiring programmer from a local tech school or from a user group to help you.

Mendel Cooper St. David, AZ

#### ANSWERS TO #9994 - SEPT. 1999

BASIC A, sometimes referred to as "Advanced BASIC" — a superset of the original IBM BASIC — was built into the chips of the original IBM machines, and did not support disk drives. IBM-DOS added BASIC A, which supported disk drives by adding some software code to the original BASIC hardware.

However, since clone-makers could not use the original IBM chips that contained BASIC without violating IBM copyright, they used MSDOS, which included GREASILY, sometimes referred to as "Gee Whiz BASIC" or "Graphics with BASIC," since it added some additional features — but would also run BASIC A

Then along came QUICK BASIC and BASIC in later versions of MSDOS and early Windows versions. These will run BASIC A only if the program is saved in the ASCII format, an option in earlier BASICs.

More recent versions of Windows do not include any version

Continued on page 86

#### ANSWERS TO #99913 - SEPT. 1999

I need to hook up my Apple Personal Laserwriter NT, with a DIN connection, to my PC running Windows 98.

#1 - The Apple LaserWriter family supports a variety of host connections, many of which are configurable by software.

A Mini-DIN 8 connector (DB-9 on the original LaserWriter and LaserWriterPlus) is used for LocalTalk (Apple's proprietary LAN) and for RS-422. A DB-25 connector is used for RS-232. An Amphenol "57" connector is used for Centronics parallel.

Not all logic board models have all interfaces, but all have at least a LocalTalk interface and an RS-232 interface.

Some LaserWriters, such as the LaserWriter II and the Personal LaserWriter, support more than one logic board type.

The easiest way to interface a LaserWriter (of whatever model and logic board type) to a PC is through the RS-232 interface.

Set the baud rate to 9600 — the LaserWriter's default — and then use the Add Printer function to set hardware handshaking. Once communications is established, it is possible to change the baud rate to 19,200 or, in some cases, to a higher rate.

Peter via Internet

#2 - The mini-DIN connection on your Personal LaserWriter NT is a LocalTalk port which is used for Apple's LocalTalk networking. You

will probably not use this port with your PC. However, that printer also has a DB-25 serial port which you can use for printing if you have an available serial port on your computer.

The cable you need looks like this:

Printer	Compute
DB-25	DB-9
2	2
3	3
4	8
5	7
6&8	4
7	5
20	1&6

The printer supports both PostScript and HP PCL emulation.

There is a configuration dial switch on the printer which sets both the emulation and the port parameters. You will probably have the best luck using the PostScript driver built into Windows.

Switch position 1 sets the DB-25 connector on the printer to serial 9600 baud, 7N1, XON/XOFF handshaking, and PostScript Batch Mode which should work with the same settings on the PC.

All of this information and more can be found in Apple's Tech Info

The two most relevant entries are "Personal LaserWriter NT: Connecting to a Windows Based PC" at http://til.info.apple.com/techinfo.nsf/artnum/n30991 and "Personal LaserWriter NT: Switch Settings" at http://til.info.apple.com/techinfo.nsf/artnum/n7439.

Doug Smith Roscoe, IL

# SURPLUS TEST EQUIPMENT

HEWLETT PACKARD	1
11666A, Reference Bridge, 0.4-18GHz \$800	١,
11667A, Power Splitter, DC-18GHz	1
11975A, Amplifier, 2-8GHz	1
16500A, Logic Analyzer Mainframe \$750	1
214B, 10MHz Pulse Generator\$1000	2
3312A, Function Generator, .1Hz-13MHz \$700 3325A, Synthesizer/Function Generator \$1000	2
3325A/01/02, Synthesizer/Function Generator \$1500	2
3335A, Frequency Synthesizer, 200Hz-81MHz	2
w/Opt. 01	
3456A, Digital Multimeter, 6.5 Digits \$800	2
3478A, Digital Multimeter \$700	2
3488A, Switch Control	2
3551A, Transmission Test Set	2
3581C, Selective Voltmeter	2 2
3582A, Spectrum Analyzer, 0.02Hz-25.5KHz \$1600	2
3585A, Spectrum Analyzer, 20Hz-40.1MHz\$4750	П
4262A, Digital LCR Meter w/Opt. 10	2
435B, Power Meter\$500	2 2
436A, Power Meter w/Opt. 022 \$1000	4
438A, Power Meter	4
4935A, Transmission Impairment Test Set w/Opt. 003	4
5316B, Universal Counter \$1000	1
5328B, Universal Counter	П
5340A, Frequency Counter w/Opt. 01/02/011 \$1000 5342A, Microwave Frequency Counter,	Н
10Hz-18GHz\$900	
54100A, Digitizing Oscilloscope\$1700	
54100D, 1GHz Digital Oscilloscope\$2700	
54110D, 1GHz Color Digitizing Oscilloscope \$2500 54201D, Digitizing Oscilloscope \$2650	1
6011A, Autoranging Power Supply, 20V/120A,	5
1000 Watt\$1200	1 7
6012A, DC Power Supply, 0-60V/0-50A, 1000 Watt \$1200	7
6034A, DC Power Supply, 0-60V/0-10A, 200 Watt\$1000 6274B, DC Power Supply, 0-60V, 0-15A\$1250	7
6475C, DC Power Supply, 0-110V, 0-100A \$3500	1
6632A, DC Power Supply, 0-20V, 0-5A, 100 Watt \$1000	
778D, Dual Directional Coupler	7   F
8082A, Dual Pulse Generator, 250MHz\$1200	1
8112A, 50MHz Pulse Generator	j
8116A, 50MHz Programmable Pulse/Function	
Generator	Ι.
8347A, RF Amplifier, 100KHz-3GHz\$2500	E
8349B, Microwave Amplifier, 2-20GHz \$4000	i
8350A, Sweep Oscillator Mainframe \$1000	E
8350B, Sweep Oscillator Mainframe	E
83545A, Oscillator Plug-in, 5.9-12.4GHz \$1750	1 8
83590A, Sweep Oscillator Plug-in, 2-20GHz,	8
Rear Output\$5500	F
8449A, Pre-amplifier, 2-22GHz\$3000 8495H, Programmable Attenuator (unused)\$600	F
8501A, Storage Normalizer \$1000	F
85021B, Directional Bridge	F
8510B, Network Analyzer w/Opt. 010 \$13,000	1
8511A, Harmonic Frequency Converter, 45MHz-26.5GHz\$5500	F
8554B, RF Spectrum Analyzer Plug-in,	F
500KHz-1250MHz	F
8562A, Spectrum Analyzer, 1KHz-22GHz\$15,000	U
8569A, Spectrum Analyzer, .01-22GHz \$5000 86222B, Sweep Oscillator Plug-in, .01-2.4GHz	1
w/Opt. 04, Rear Output and 8620C Mainframe \$1250	1
86290A, RF Plug-In, 2.0-18GHz	1
86290B, RF Plug-In, 2.0-18.6GHz	1
8640A, Signal Generator, 0.5-512MHz \$700	F
8640B, Signal Generator, Opt. 002, .5-1024MHz \$2100	1
8640B, Signal Generator, Opt. 1, 2	1
8654A, Signal Generator, 10-520MHz\$450 8656A, Signal Generator, 100KHz-990MHz\$1700	
8656B, Signal Generator, 0.1-990MHz w/Opt. 02 \$2250	1
8660C, Synth. Signal Generator w/Opt. 1 & 100 \$1000	
86603A, RF Plug-In, 1-2600MHz	1
8671B, Synthesized CW Generator\$5500	1
8672A, Synth. Signal Gen., 2.0-18.0GHz\$4000	1
8672A, Synth. Signal Gen., 2GHz-18GHz,	1
W/Opt. 08	1
8748A, S-Parameter Test Set w/Opt. 026 \$1350 8753A, Network Analyzer, 300KHz-3GHz \$5500	1
8753A, Network Analyzer, 300KHz-3GHz	1
w/Opt. 010\$6500	1
8756A, Scalar Network Analyzer	1
8970A, Noise Figure Meter	1
TEKTRONIX	1
11A32, Two Channel Amplifier Plug-In,	1
DC 400MU+ \$1250	11.

1A34, Four Channel Amplifier Plug-In.
DC-300MHz\$1500
1A52, 600MHz Two Channel Vertical Amplifier \$700
1A71, Amplifier, DC-1GHz\$450
1A72 Two Channel Amplifier Plug-In
DC-1GHz\$850
DC-1GHz
2215, 60MHz Oscilloscope
2236, 100MHz Oscilloscope
w/Counter/Timer/DMM\$1000
2246, 100MHz Oscilloscope
2247A, 100MHz Oscilloscope w/Counter/Timer/
Voltmeter\$2500
2337, 100MHz Oscilloscope w/DMM \$1650
2430A, 150MHz Digital Oscilloscope\$2850
2430R, 150MHz Digital Storage Oscilloscope \$1850
2432A, 300MHz Digital Storage Oscilloscope \$3000
2445, Four Channel 150MHz Oscilloscope \$1500
2465, Four Channel 300MHz Oscilloscope \$2500
2465A DV, Four Channel 350MHz Oscilloscope \$3850
2465CTS, Four Channel 300MHz Oscilloscope
w/CCT/WR\$2500
2467. Four Channel 350MHz Oscilloscope \$3000
2467B, Four Channel 400MHz Oscilloscope \$6000
2630, Fourier Analyzer
66, 100MHz Storage Oscilloscope w/DM44 \$800
75, 200MHz Oscilloscope
75A, 250MHz Oscilloscope
192P, Programmable Spectrum Analyzer,
The same and the s
VISIT OUR WEBPAGE AT
AISH OOK MEDLAGE WI
WALL DESTINATION OF THE SAME
WWW.RSSURPLUS.COM

50KHz-21GHz w/Opt. 1/2/3
577/D2, Curve Tracer, Non-storage w/177 Fixture \$175
7D20, Programmable Digitizer \$40
7L5/L3, Spectrum Analyzer, 20Hz-5MHz,
w/Opt. 025 Tracking Generator \$185
7L12, Spectrum Analyzer, 100KHz-1.8GHz \$150
7L18, Spectrum Analyzer Plug-in, 1.5-18GHz
Capable of 60GHz with Mixers\$250
7S12, TDR/Sampler
RTD710A, Digitizer w/Opt. 1R (Rackmount) \$375
TM5003, Three Slot Power Mainframe \$45
TM5006, Six Slot Power Mainframe

# MISCELLANEOUS cme Elect. PS2L1000, Electronic Load . . . . . \$850 atron 1061A, 6.5 Digit Autocal Multimeter, DC Only . . . \$700

canon too and one colds a success and an analy and condition and
Datron 1062, 6.5 Digit Autocal Multimeter, DC/AC/Ohms \$900
EIP 545A, Microwave Frequency Counter \$800
EIP 548A, Frequency Counter, 10Hz-26.5GHz \$2000
EIP 548B, Frequency Counter, 10Hz-26.5GHz \$3250
EIP 578, Source Locking Frequency Counter \$2500
Electro-Metric NTR-51C, Receiver
Fluke 5200A, AC Voltage Calibrator w/5205A Amp \$1850
Fluke 7261A, Universal Counter/Timer,
0Hz-125MHz
Fluke 8010A, Digital Multimeter
Fluke 8012A, Digital Multimeter
Fluke 8050A, Digital Multimeter \$250
Fluke 8502A, Digital Multimeter, DC Only\$225
Fluke 8520A, Digital Multimeter
Fluke 8600A, Digital Multimeter
Fluke 8810A, Digital Multimeter
Fluke 8840A, Digital Voltmeter w/Opt. 059 \$600
Keithley 195A, Digital Multimeter
LeCroy 7200, Precision 400MHz Digital Oscilloscope
w/ (2) 7242B Plug-ins
LeCroy 9450, 350MHz High Performance Digital
Oscilloscope
Marconi 2019A, Signal Gen., 80KHz-1040MHz \$2200
Polarad 1105E-FT, Signal Generator, 0.8-2.4GHz \$400
Systron Donner 1730B, Frequency Synthesizer,
.01-26.5GHz
Trans. Devices DLR400 15 3500A, Dynamic Load . \$1500
Trans. Devices DLP 50-60-1000A, Electronic Load \$800
Tians. Devices DE SO OF TOOM, Electionic Edge 9000

\( 01-26.5\Ght 2 \)
\( 01-

Wavetek 171, 2MHz Synth. Function Generator \$450
Wavetek 172, Programmable Signal Source
w/Opt. 01/02 \$1500
Wavetek 178, Automatic Synthesizer. \$1700
Wavetek 178, Automatic Synthesizer. \$1700
Wavetek 852, Dual Hi/Lo Filter \$1000
Wavetek 2001A, Sweep Generator, 1-1400MHz \$450
Wavetek 2000A, Signal Generator . \$2250
Wavetek 3000-200, Signal Generator . \$900

Wavetek 8003, Precision Scalar Analyzer,
10MHz-40GHz. \$2000
Wavetek 8501, Peak Power Meter \$2000
Wavetek 8502, Power Meter, 30MHz-40GHz. \$3500
Wiltron 560-7S50, RF Detector, 10MHz-18.5GHz. \$300
Wiltron 6747B-20, Frequency Synthesizer,
10MHz-20GHz, w/Opt. 01 & 02. \$13,500



DC-400MHz.....\$1250

R & S Surplus
1050 E. CYPRESS STREET, COVINA, CA 91724

VISA

(626) 967-0846 · FAX (626) 967-1999

# AMATEUR ROBOTICS

# HOTEBOOK

\*\* Create I2C STOP Condition

by Robert Nansel

ast month, I covered the more intricate details of I2C timing, including multimaster bit arbitration and clock synchronization and stretching. I then showed a simple logic circuit that detects I2C START and STOP conditions—an essential tool for triggering an oscilloscope to display I2C signals.

Unfortunately, in my discussion of bit arbitration, I said that the ninth bit transmitted by a master is the R/W bit, which is flat wrong. It's the eighth bit. The ninth bit is the ACK bit. It was shown correctly in the illustration. Sorry for any confusion this may have caused.

This month, I'll jump right into building a software-only I2C master.

#### It's all in the timing

Writing a software-only master is not too difficult because excellent pseudocode is available from Vincent Himpe's I2C FAQ (www.ping.be/~ping0751/i2cfaq/i2 cfaq.htm), and the data timings are fairly relaxed.

Software slaves are another story. The immediate problem you face is getting the slave to reliably detect a START condition. A master, (unless it can also be addressed as a

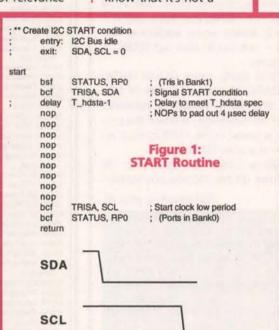
slave), doesn't need to detect START, only that the bus is free and, if the bus is not free, a master can usually wait until it is.

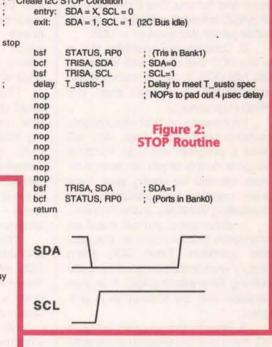
Not so with a slave. A slave must know the I2C bus state at all times. In the absence of hardware to detect START, it must sample the bus continually at a rate that guarantees it will detect START within a few microseconds of its occurrence.

The first number of relevance

here is tbuf: the amount of time the bus must be free after the last STOP and before the next START can be asserted. The minimum is 4.7 microseconds, and a software slave must sample both SDA and SCL at least twice during that time to determine if the bus is free.

For a 10 MHz 16F84, this ordinarily would mean that you'd have only five or six processor cycles for the loop; very tight. If a slave could sample the bus every five processor cycles, there could be as much as a five-cycle (2 usec) delay before the slave would recognize START. There are ways to relax the sampling rate requirement, but for now it's sufficient to know that it's not a





trivial problem.

For a master, however, the important thing to remember is that it's not trying to detect a 4.7 usec bus free condition, but to detect a bus free condition that is at least that long. It's okay, for example, for masters to allow the bus to idle longer than that. The bus is intended to be lightly loaded, but if a master waits too long, it may lose its chance at the bus that time around should a faster master assert START in the mean time.

The second number of concern is thd;sta: the hold time for START. This is 4.0 usec minimum from the time SDA drops low until SCL begins to go low, or 10 processor cycles. The third number is tlow: the 4.7 usec minimum time SCL must be low during each bus clock pulse. This is 11 processor cycles.

Assuming a slave can detect START, these numbers are easier for it to deal with, especially since what the slave really cares about is detecting the first and subsequent data bits. Referring to the timing diagram and table values from last month, this means the slave has thd;sta + tlow = 8.7 usec before SCL goes high. Actually, it might be less since you have to figure in, worst case, the above mentioned 2-usec delay between the master's assertion and the slave's recognition of START.

This gives the slave only 6.7 to 8.7 usec — 17 to 21 cycles — to get ready to receive the first bit. If the slave has the same 0 to 2 usec delay for recognizing the rising

# CABLE TV CONVERTERS



Raven-85 plain converter: 85 channel, Ch-3 output, PG Lock, HRC/STD and sleep timer

Raven-99 plain converter: 99 channel, Ch-3 output, PG lock, MFT/Fine tuning, HRC/STD and sleep timer

Raven-135 converter: Volume control, 135 channel, Ch-3/4 output, PG lock, HRC/STD and sleep timer, audio & video output through RCA jacks

Raven-125 converter: Volume control, 125 channel, Ch-3/4 output, PG lock, HRC/STD(by remote unit) and sleep timer, audio & video output thru RCA jacks

FREE BROCHURES & PRICE LIST

CALL (310) 515-5085 or FAX 1-800-579-5000 PCW Company Honey, I shrunk the COMPUTER!

PicStics are like BASIC Stamps® on steroids. They have more speed, more parallel I/O, more code and data space, and more neat features like a real-time clock, 12-bit ADC, and 12-bit DAC. DicStic 4

As low as \$29

Call for a catalog or visit our Web site today.

www.micromint.com



(800) 635-3355 (407) 262-0066

FL 32750 BASIC Stamp is a registered trademark of Parallax

# MOREBOOK

edge of SCL, then it would sample SDA somewhere during the first half of thigh. This would probably work, but the slave wouldn't be doing much else.

The only real way to know if it will work, though, is to build a slave and test it out. But, in order to test the slave, you have to have a master to test it with.

#### In Search of a Master

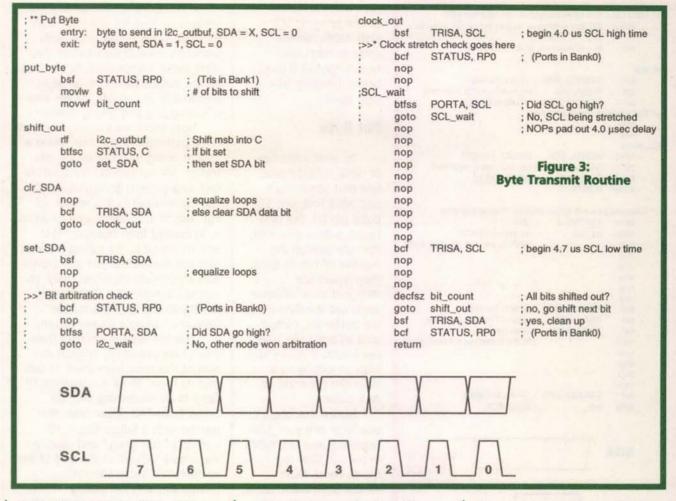
For the next couple articles of this series, I'll be presenting I2C project software as a work-in-progress. That means the code will be functional, but it might also be uglier than normal, and quite probably buggy. I'm approaching this as an iterative process: build and test, refine, and repeat the process until I have a working system. It's a useful way to go about implementing any system of modest complexity. As Fred Brooks of The Mythical Man-Month fame says, "Plan to throw one away; you will anyway."

Despite all my study, I won't really understand the problem until I've implemented a solution at least once. With luck, the second time around maybe I'll have learned enough to do it right.

The first job, then, is to build enough of a master to produce inspec I2C waveforms. Now, since the I2C spec calls for open collector drivers, how do you implement this with a PIC16F84, which doesn't have open-collector outputs available? There is a trick.

What I2C needs is a low-impedance output when outputting a logic zero and a high-impedance (i.e., floating) output when outputting a logic one. If you place a zero in an I/O pin output latch, that will take care of the low-impedance zero output when its corresponding TRIS bit is zero (TRIS=0 configures the pin as an output).

Writing a one to TRIS configures the I/O pin as a high-impedance



input. The external pull-up resistor pulls the high-impedance output up to logic one. All you have to do, then, is initialize the output latches for SDA and SCL with zeros, then thereafter write the desired I2C levels directly to the TRIS register.

The only complication is that you must remember that writes to the I2C bus are done by writing to the TRIS register (which is in Bank 1), not to the port itself (which is in Bank 0). Reads are still done by reading directly from the I/O pins of the port. Anyway, it's time to stop talking theory and start banging bits together.

#### START & STOP

Appropriately, first up is the

routine that generates the I2C START condition. Figure 1 shows Start, as well as the waveform it generates. On entry, it assumes that the bus is idle, SDA and SCL both high. It asserts START by bringing SDA low while SCL remains high. It then delays thd;sta (4.0 usec) with a series of NOPs before bringing SCL low to begin the low period before the first SCL clock cycle.

Eventually, I'll write a macro that will accept as an argument the number of processor cycles to delay. This would allow me to generate more code-space efficient delays than long strings of NOPs but, for now, this is commented out. NOPs may not be elegant, but they get the job done.

Also note the following conven-

tion: I set to Bank 1 on entry to, and reset to Bank 0 on exit from, every routine. I could shave two processor cycles from each routine if I let every routine assume Bank 1 on entry and exit, switching to Bank 0 only as needed, but this could lead to hard-to-diagnose bugs outside of the routines.

I've opted instead for the simplicity of always operating from Bank 0 until I need to access registers (such as TRIS) in Bank 1, then switching back before exiting. If, in later development, I need extra processor cycles, I can change this.

The Stop routine in Figure 2 is quite similar to the Start routine. Stop cannot assume that SDA is already low on entry, and, since SDA must be low before STOP is

#### Explore Fuzzy Logic with the AL220 device and Fuzzy Logic Applications Expert (FAE) Development System.

The AL220 Device is a complete Single Chip Fuzzy Logic microcontroller which contains 4 analog inputs and 4 analog outputs. It was voted the most innovative product of 1994 by EDN magizine. Now it is available with a complete PC based development system, programmer, and real time hardware Emulator for hobbiest as well as professionals! Check out our web site at www.BasiConcepts.com for free data sheets, application notes, and additional product information.

Order	Description	Price Each
AL220	18 Pin Dip AL220 Device	\$12
FAE	FAE Dev System for Win 95/98 on CD	\$65
Hobby Pack	AL220, FAE, and Printer Port Programmer	\$95
Professional Pack	AL220, FAE, Programmer, and Real Time Hardware Emulator System	\$495

BasiConcepts, Inc. 312 W. First St. Suite 201, Sanford, FL 32771 Tel: (407)322-5608 Fax: (407)322-5609 Email: info@BasiConcepts.com

#### SATELLITE TV - HACKERS 'BIBLE'!

#### The SECRETS are REVEALED!

- The principles of security
- Descrambler building blocks
- Smart cards, information wars & stupid mistakes Cracking codes (includes DirecTv source code)
- Installing and hooking up descramblers
- Video manipulative systems...and much more...

#### www.baylin.com or... call 800-483-2423

ORDER via Internet or Send \$60 plus \$5 s/h to: Baylin Publications, 1905 Mariposa, Boulder, CO 80302

MASTER, VISA & AMEX /COD orders accepted

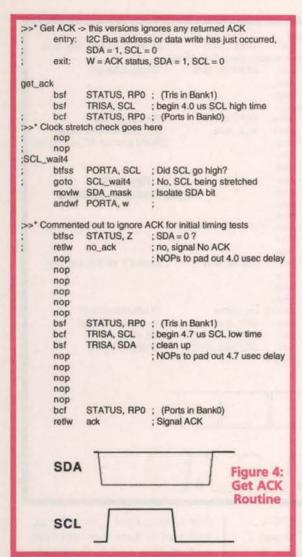


576 pages, 6" x 8-1/2"

NEW! 5th Edition

Telephone: 303-449-4551 FAX: 303-939-8720

FREE CATALOG - Satellite TV books, videos and software



asserted, I set it low before bringing SCL high. NOPs force a delay to meet the tsu;sto spec (4.0 usec) before bringing SDA high again.

#### **Put Byte**

To send addresses or data. I need a routine that sends eight bits, MSB first, one SCL pulse per bit. Put byte in Figure 3 does this. First, Put byte sets up the number of bits to send, then enters the shift\_out loop, which shifts out the data in the buffer i2c\_outbuf until all eight bits have been sent. It leaves SDA high on exiting so a slave can generate an ACK pulse.

Notice that there is one NOP in the clr\_SDA segment, and two NOPs in the set\_SDA segment. These NOPs ensure both branches of the loop execute in the same amount of time, in particular that SDA is set or cleared after the same amount of time for every bit. This isn't strictly necessary since both branches are executed before the clock pulse is generated, but I wanted the output waveform to be as predictable as possible for the sake of debugging and timing checks.

Note there are two segments of code commented out. The first is a stab at doing multimaster bit arbitration. It's not needed for a simple test data pattern generator, so it's commented out in this version of Put byte. It also needs a bit of work in its current form because: 1) It doesn't signal to the calling routine that this master has just lost arbitration and should therefore make an access attempt later; 2) It jumps directly to the i2c\_wait routine instead of doing a proper return.

This last wart is left over from when I converted my original version of this code from inline to subroutine form. To fix it, I suppose I'll need to do something like use "retlw failure" to return from the routine with a failure flag in W instead of the "goto," and replace the simple "return" at the end of the routine with "retlw success" ... (What, you only like eating sausages, not watching them being made?)

The second commented-out

segment is a first try at making the master aware of clock stretching. It hasn't been tested, and it has one known bug that would hang the processor as long as SCL is held low. There really needs to be a timeout on this so the master can recover from a bus fault condition, if only to dump debug information to help track down the problem. When I have a slave capable of doing clock stretching, though, it should suffice for initial testing.

#### **Get ACK**

Figure 4 shows the Get ACK routine. For my first tests, I knew I wouldn't have a slave hooked up to the master, so there would be nothing to respond to the master with an ACK pulse. To deal with this, I simply commented out the instructions that check for an ACK. Unlike Put byte, Get ACK does signal success or failure (or will when the ACK-check segment is uncommented).

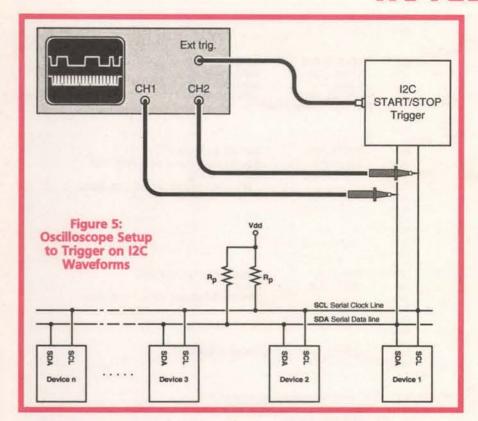
Get ACK also has its clockstretch check commented out (also with the same timeout bug as above). In preparing this article, I found a different, more subtle bug in this segment. Can you spot it?

The sharp-eyed among you might have already noticed that I

```
title "testmast asm"
; testmast.asm - Generate I2C Master test data pattern
; (c) 1999 by Robert Nansel
; This program is free software; you can redistribute it and/or
; modify it under the terms of the GNU General Public License as
; published by the Free Software Foundation. Details of the GNU
 GPL can be found at www.fsf.org or by writing to the Free Software Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307, USA.

It comes with ABSOLUTELY NO WARRANTY, implied or otherwise.
    LIST P=16F84, F=INHX8M, R=DEC ; 16F84 Runs at 10 MHz
    errorlevel 0,-305
INCLUDE "\progra~1\mplab\p16F84.inc"
; Registers
 __CONFIG _CP_OFF & _WDT_OFF & _HS_OSC & _PWRTE_ON
i2c_clr
                              equ
                              equ
0x03
i2c_set
                                              Dx03
idle_out equ
start_out equ
                              0x01
                                              0x00
                                              OxFF
no_ack
                              equ
                                                               Ser. Clock, bit 0 PortA
SCL
                                              0
                              eau
SDA
                                                             ; Ser. Data, bit 1 PortA
                               equ
                                              0x02
SDA mask
                              equ
; ** Delay values
; (these will eventually be used when invoking the delay macro)
                                                                                              10 MHz XTAL
F Osc
                               equ
                                               10000/((F_Osc*10)/4)
                                                                                             T_cyc ns/cycle
4700 ns
T_cyc
T_buf
                               equ
                                              ((47000/T_cyc)+5)/10
((40000/T_cyc)+5)/10
((47000/T_cyc)+5)/10
((40000/T_cyc)+5)/10
                              equ
                                                                                              4000 ns
T_hdsta
                              equ
                                                                                              4700 ns
 T_low
                               equ
                                                                                              4000 ns
T high
                              eau
                                              ((40000/T_cyc)+5)/10
                                                                                              4000 ns
T susto
; RAM Usage
               CBLOCK 0x00C
```

```
_w
_status
                      : ISR context storage
bit_count; bit shift counter
i2c_outbuf; outpu
; output buffer i2c_inbuf; input buffer temp
                                                               Listing
temp
                       : temporary storage
           ENDO
           PAGE
           org 0
 ** Test datagram write
           entry
           exit:
test
           call
                       i2c init
test2
           call
                       i2c wait
                                              ; Wait for bus free condition
                      start
0x70
                                              Create START condition
Set to write to addr 0111000b
            call
           movlw
                       i2c_outbuf
           movwf
           call
                       put_byte
                                             ; Send the address & R/W flag
                       get_ack
0xB5
           call
                                              ; Set up data 10110101b
           movlw
                       i2c_outbuf
            movwf
                       put_byte
get_ack
                                             : Send data
           call
           call
                                              ; Create STOP condition ; repeat forever
                       stop
test2
            call
           goto
i2c init
            bsf
                       STATUS, RPO
                                                (Tris in Bank 1)
           movlw
andwf
                       i2c_set
TRISA
                                               Set up PAO, PA1 as inputs
                                                (Ports in BankO)
            bcf
                       STATUS, RPO
            movlw
                                               Set up active low zeros
            andwf
                       PORTA
                                              in PORTA
           return
  ** Wait for I2C Bus Free condition
; (paranoid version)
i2c_wait
           bsf
                       STATUS, RPO
                                                (Tris in Bank1)
                                               Get I2C bits
            movf
            andlw
                       i2c_clr
```



commented out the switch to Bank 0 at the top of the segment; that causes the next two instructions to access TRIS instead of PORTA as intended. I corrected this in the main listing, but left the bug in the figure as an object lesson.

Other than decreasing execution time by one cycle, the bug doesn't affect the operation of this routine. Why? Because the routine ignores the results of those instructions!

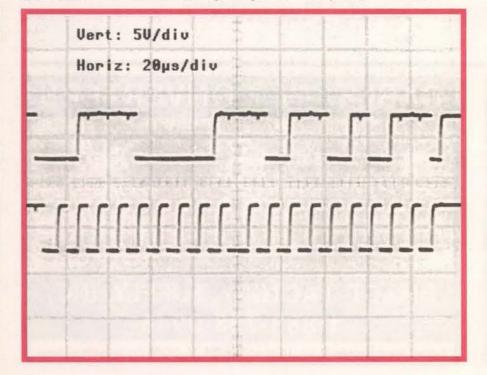
The bug would have reared its head only had I tried testing the code with the ACK-check uncommented. It would have always acted as if the slave had given an ACK, even if it hadn't. More sausage.

#### Making a Datagram

With the above four routines, (plus i2c\_init and I2c\_wait in Listing 1), we can put together a simple program that generates I2C test data waveforms. The main routine test first calls i2c\_init to set up the I/O lines, then i2c\_wait to ensure the bus is free before transmitting. There is only one master and no slaves in this test, so the bus should be idle (if it isn't, there's a hardware problem).

The program asserts START by calling Start. Next, it loads i2c\_out-buf with the address (binary 0111000) in the upper seven bits and the R/W bit (binary 0, a write) in the LSB, and it calls put\_byte to send the address and R/W bit. This is followed by a call to get\_ack to generate a dummy ACK pulse.

The second byte of the datagram — the data itself — (binary 10110101), is sent in the same fashion, also followed by a call to get\_ack. Finally, stop is called, and



	iorlw	idle_out ; SCL=1,	SDA=1
	movwf	TRISA	; Output bus pin values
	bcf nop	STATUS, RPO	; (Ports in Bank0) ; Let bus settle 1.2 usec to
wait2	movlw	idle_out	; meet I2C 1 usec max rise time ; SCL=1, SDA=1
WaitZ	xorwf	PORTA, w;	Check bus state
	andlw btfss	i2c_set STATUS, Z	: I2C bus idle?
	goto	wait2	; No, go wait for bus idle
	moviw	idle_out	; Yes, continue 2C bus state 2nd time
	andlw	i2c_set	;
	btfss	STATUS, Z wait2	; Bus still idle?
	movlw	idle_out	; No, go wait for bus idle ; Yes, continue
	xorwf andlw	PORTA, w i2c_set	; Check I2C bus state 3rd time
	btfss	STATUS, Z	; Bus still idle?
	goto	wait2	; No, go wait for bus idle
; ** Crea		ART condition I2C Bus idle	
;	exit:	SDA, SCL = 0	
start			
3.01.1	bsf	STATUS, RPO	; (Tris in Bank1)
	bcf delay	TRISA, SDA T_hdsta-1	; Signal START condition ; Delay to meet T_hdsta spec
4	nop	- Jasea I	; NOPs to pad out 4 usec delay
	nop		
	bcf	TRISA, SCL	; Start clock low period
	bcf return	STATUS, RPO	; (Ports in Bank0)
	100011		
: ** Crea	te I2C STO	OP Condition	
	entry:	SDA = X, $SCL = 0$	
8 110	exit:	SDA = 1, SCL = 1 (	I2C Bus idle)
stop			
	bsf bcf	STATUS, RPO TRISA, SDA	; (Tris in Bank1) ; SDA=0
	bsf	TRISA, SCL	; SCL=1
;	nop	T_susto-1	; Hard-coded 4 usec delay
	nop		
	nop bsf	TRISA, SDA	: SDA=1
	bcf	STATUS, RPO	; (Ports in Bank0)
	return		
	D. 4		
; ** Put	Byte entry:	byte to send in i2c	outbuf, SDA = X, SCL = 0
1	exit:	byte sent, SDA = 1	
put_byte			
	bsf	STATUS, RPO	; (Tris in Bank1)
	movlw	8 bit_count	; # of bits to shift
chift was			
shift_out	rlf	i2c_outbuf	; Shift msb into C
	btfsc	STATUS, C	; If bit set
	goto	set_SDA	; then set SDA bit
clr_SDA	non		t equalize loops
	nop bcf	TRISA, SDA	; equalize loops ; else clear SDA bit
	goto	clock_out	
set_SDA			
	bsf	TRISA, SDA	· equalize loops
	nop		; equalize loops
	200	chack	
BIL	arbitration bcf	STATUS, RPO	; (Ports in Bank0)
	nop btfss	PORTA, SDA	; Did SDA go high?
1	goto	i2c_wait	; No, other node won arbitration
clock_ou	100		
LIUCK_UU		TRISA, SCL	; begin 4.0 us SCL high time
	bsf	INISA, SCL	, begin 4.0 do ser riigir diric

' Cloc		check goes here			exit:		
	bcf	STATUS, RPO	; (Ports in Bank0)	give_ack	1		
	nop				bsf	STATUS, RPO	; (Tris in Bank1)
CL_wait					bcf bsf	TRISA, SDA TRISA, SCL	; Output ACK pulse ; begin 4.0 us SCL high time
	btfss	PORTA, SCL	; Did SCL go high?		bcf	STATUS, RPO	; (Ports in Bank0)
	goto	SCL_wait	; No, SCL being stretched	** Cloc		check goes here	, (rors in banko)
	nop		; NOPs pad out 4.0 usec delay		nop	distant good nero	
	nop			9 9	nop		
	nop			;SCL_wai			
	nop			301 30	btfss	PORTA, SCL	; Did SCL go high?
	nop			3	goto	SCL_wait3	; No, another node is stretching clock
	nop				bsf	STATUS, RPO	; (Tris in Bank1)
	nop				nop		; Hard-coded to pad out 4.0 usec delay
	nop				nop		
	nop				пор		
	bcf	TRISA, SCL	; begin 4.7 us SCL low time		пор		
	nop				nop		
	nop				nop		
	nop	folk manual	80 52- 325-1-12		nop	TO 10 4 10 11	
	decfsz	bit_count	; All bits shifted out?		bcf	TRISA, SCL	; begin 4.7 us SCL low time
	goto	shift_out TRISA, SDA	; no, go shift next bit		bsf	TRISA, SDA	; clean up
	bcf	STATUS, RPO	; yes, clean up ; (Ports in BankO)		nop		; Hard-coded to pad out 4.7 usec delay
	return	377103,1110	, (Cold in bulks)		nop		
	Section 1				nop		
1 300			Sharper and the same of the sa		nop		
>>* Get		ote: this routine not y	et tested		bcf	STATUS, RPO	; (Ports in Bank0)
	entry:				return		STATE OF THE PROPERTY OF
	exit:						
et_byte				135* Got	ACK > +	nis versions ignores	any returned ACK
	movlw	8	; # of bits to shift	i- det	entry:		or data write has just occurred,
	movwf	bit_count			21111	SDA = 1, SCL = 0	
	clrf	i2c_inbuf	to any superior	*	exit:	W = ACK status,	
	bcf	STATUS, C	; Clear C to shift in zeros				
	bsf	STATUS, RPO	; (Tris in Bank1)	get_ack	hat :	CTATUS DDG	Property Resident
nift_in	bsf	TRISA, SCL	hagin 4.0 us SCI high time		bsf	STATUS, RPO	; (Tris in Bank1)
	bcf	STATUS, RPO	; begin 4.0 us SCL high time ; (Ports in Bank0)		bsf bcf	TRISA, SCL STATUS, RPO	; begin 4.0 us SCL high time ; (Ports in Bank0)
		check goes here	, (Loris III ballico)	>>* Cloc		check goes here	, (FOLS III Ballico)
LIOCK	nop	and goes here		, Cloc	nop	chices goes field	
	nop				nop		
CL_wait	2			;SCL_wai	t4		
	btfss	PORTA, SCL	; Did SCL go high?		btfss	PORTA, SCL	; Did SCL go high?
	goto	SCL_wait2	; No, another node is stretching clock		goto	SCL_wait4	; No, SCL being stretched
	movlw	SDA_mask	; Isolate SDA bit		movlw	SDA_mask	; Isolate SDA bit
	andwf btfsc	PORTA, w; STATUS, Z; SDA = 1	2		andwf	PORTA, w;	
	bsf	i2c_inbuf, 0	; yes, set LSB	'>>* Com	mented	out to ignore ACK f	or initial timing tests
	D31	izc_indui, o	; else, LSB already clear	COII	btfsc	STATUS, Z; SDA =	0 7
	rrf	i2c_inbuf;			retlw	no_ack	; no, signal No ACK
	nop		; Hard-coded to pad out 4.0 usec delay		nop	Section of the second	; NOPs to pad out 4.0 usec delay
	nop				nop		
	bsf	STATUS, RPO	; (Tris in Bank1)		nop		
	bcf	TRISA, SCL	; begin 4.7 us SCL low time		nop		
	nop		; Hard-coded to pad out 4.7 usec delay		nop		
	nop				nop bsf	STATUS, RPO	; (Tris in Bank1)
	nop				bcf	TRISA, SCL	; begin 4.7 us SCL low time
	non				bsf	TRISA, SDA	; clean up
	nop		; All bits shifted in?		пор		; NOPs to pad out 4.7 usec delay
	nop nop decfsz	bit_count			nop		
	nop decfsz goto	shift_in	; no, go shift next bit		HOP		
	nop decfsz goto bsf	shift_in TRISA, SDA	; yes, clean up		nop		
	nop decfsz goto bsf bcf	shift_in	; no, go shift next bit ; yes, clean up ; (Ports in Bank0)		nop nop		
	nop decfsz goto bsf	shift_in TRISA, SDA	; yes, clean up		nop nop		(0-4-1-0-10)
	nop decfsz goto bsf bcf	shift_in TRISA, SDA	; yes, clean up		nop nop nop bcf	STATUS, RPO	; (Ports in BankO)
	nop decfsz goto bsf bcf return	shift_in TRISA, SDA	; yes, clean up ; (Ports in Bank0)		nop nop	STATUS, RPO ack	; (Ports in Bank0) ; Signal ACK

# Lowest Dealer Price Available

	5+	10+	20+
Refurb. Panasonic 145	\$45	\$40	\$35
Regal w/Remote	\$38	\$35	\$30
BC4535 86 Channel	\$30	\$28	\$25
Oak Sigma 99 Channel	\$45	\$40	\$35
75 Channel Converter	\$18	\$18	\$18
Zenith ST1600 w/Remote	\$75	\$70	\$65
Panasonic Converters Model-175	\$65	\$55	\$45
(550MHz) Six month's w	varranty on	this mor	del only

Call us today to satisfy all your cable equipment needs!

# SAM'S ELECTRONICS 1-405-631-1856

All Cable Equipment is unmodified.

# CABLE TV CONVERTERS

	5 lot	10 lot	20 lot	100+
Viewstar MXC - 2020 85 CH Plain Converter PG Lock HRC/STD SleepTimer	\$45.	\$40.	\$35.	\$30.
→ Century CTC - 3000 99 CH Plain Converter	\$50.	\$45.	\$40.	\$35.
PG Lock HRC/STD SleepTimer  Wireless Video Senders  Transmits Aud/Vid to any TV	\$20.	\$18.	\$15.	\$13.
→ REM -100 Magnavox 3 in 1 Univ. Remote control	\$ 6.	\$ 5.30	\$ 4.75	\$ 4.

All converters are factory new with remote control. Call us today for all your cable accessory needs.

# DIRECT FACTORY SUPPLY, INC. 1-888-748-0946

E-MAIL YOUR REQUESTS TO: DIRFACSUP@AOL.COM (No Descrambler Sales)



ON-LINE CATALOG

www.weedtech.com

PO Box 2426, Ft. Walton Beach, FL 32549

Voice/Fax 850-863-5723

Phone Line Transponder

7 individual output pins are controlled with buttons 1-7 on your touch-tone phone. Automatically answers telephone and waits for commands, Monitor room noises with built in mic. "Dial-Out" pin instructs unit to pick up phone and dial user entered number(s), Password protected. \$49

#### Stackable RS-232 Kits

Digital I/O - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 16 modules on same port for 192 I/O points. Turn on/off relays. Sense switch transistions, button presses, 4x4 matrix decoding using auto-debounce and repeat.

Analog Input - 8 input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alaam trip-points for each input. DilP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. \$48

Home Automation (X-10) - Connects between a TW523 and your serial port. Receive/transmit all X-10 commands with your home-brewed programs. Full collision detection with auto re-transmission. \$39

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ascii character string. Example: \*12/31 08:45 850 863-5723 Weeder, Terry < CR>\*. Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. \$35

Touch-Tone Input - Decodes DTMF tones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation and/or Digital I/O kits using a remote telephone. \$34

# DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in non-volatile memory. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program.

#### **IR Remote Control Receiver**

Learns and responds to the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either toggle" or "momentary" action.

#### **Telephone Call Restrictors**

Two modes of operation; either prevent receiving or platelephone calls (or call prefixes) which have been entered memory, or prevent those calls (or call prefixes) which have ory, or prevent those calls (or call prefixes) which have a entered into memory. Use touch-tone phone to program.

Block out selected outgoing calls. Bypass at any time using your password.

Block out selected incoming calls. Calls identified using Caller ID data.

# NOTEBOOK

 except for i2c\_init — the whole procedure repeats.

The result is the datagram is repeatedly output to the I2C bus. With the I2C START/STOP trigger circuit from last month, it's easy to observe the complete waveforms on the oscilloscope to verify timing parameters. The oscilloscope set-up is shown in Figure 5, and the actual waveforms I observed are in the photo - a screenshot of my 'scope.

#### Linux Update

As usual, I'm running out of space before I've run out of material. A quick update on my new development system:

I've got my Linux box up with Red Hat 6.0. I'm learning my way around the system, and relearning via the editor I loved to hate in college. I've also learned that the best Linux books aren't always the thickest ones, nor even the most recent.

Case in point: Running Linux, 2nd ed. by Matt Welsh and Lars Kaufman (ISBN1-56592-151-8, O'Reilly) was published back in 1996. There are very few screenshots or instructions specific to one distribution, and there's no CD-ROM included. All the same, this one is my favorite Linux book. The information in it is as timeless as it's possible to be in this field.

By comparison, Naba Barkakati's Red Hat Linux Secrets (900+ pages plus a CD-ROM!) published in 1998 is already quite dated since it assumes you're dealing with Red Hat 5.1. It might work for you, but I couldn't bring X-Windows up with 5.1 (it didn't recognize my video card)

I could have with Running Linux because it gives enough

examples. And even though Running Linux has only 630 pages, O'Reilly books traditionally emphasize clear writing over flashy screenshots, so there's more useful information and examples crammed into those pages than Barkakati's. And it costs 40% less.

As it turns out, a third edition of the book should be available by the time you read this, so the best old book on getting started with Linux is now the best new book. The price is a couple dollars more (they added some pages), but well worth it.

My recommendation: Skip the books with CD-ROMS, buy the Welsh book, and order one of the \$1.98 Linux distributions from Linux Mall. You could pick up a Penguin Power T-shirt, too, while you're there, and still save money.

#### Later, y'all

Next time: more I2C, more Linux, more robotics, and a surprise or two. NV

As always, if you have suggestions for improving Breadbot, if you've built a Breadbot, or if you have questions or comments about amateur robotics topics, you can reach me at:

**Robert Nansel** 69 S. Fremont Ave. #2 Pittsburgh, PA 15202 E-Mail: bnansel@nauticom.net

# ELECTRONIC TEST EQUIPM

90 DAY WARRANTY PARTS & LABOR • 10 DAY RIGHT OF RETURN, OPEN ACCOUNTS

		DAY RIGHT OF RETURN, OPEN ACCOUNTS
Allach 200011 Fraguency Sup. 01 20Uz	eenn	UD 07/24/010 Defection Transmission Total Cal 10CU.
Ailtech Type 32, Precision Attenuator, 0-100dB	\$300	HP 8743AVU18, Hellection Transmission Test Set, 18GHZ . \$300
Argosystems AS210, Frequency Calibration System	. \$2,000	HP 8753R Network Analyzer Oct 002 006 010 98 000
Austron 2100R, Loran-C Frequency Monitor	\$250	HP 8743A/018, Reflection Transmission Test Set, 18GHz \$300 HP 8750A, Storage Normalizer, Includes Cable \$250 HP 8753B, Network Analyzer, Opt. 002,006,010 \$8,000 HP 8756A, Scalar Network Analyzer \$1,500 HP 8901A, Modulation Analyzer \$1,000 HP 8903B, Audio Analyzer, Opt. 001 \$2,000 HP 8903B, Audio Analyzer, Opt. 001 \$2,000 HP 8902D, Dual-Mode Cellular Mobile Test System Opt. 002,008,014 \$8,500 HP E3617A, DC Power Supply, 0-40V, 1A \$250 HP P486A, Power Sensor, 12.4-18GHz \$100 HP X486A, Power Sensor, 12.4-18GHz \$100 Hughes 8010H, TWT Amplifier, 3-8GHz \$1,000 Huntron 5100DS, Computer Controlled Troubleshooting System \$1,200 Settliber 1202 Powersmank DMAR 5.5 District HP \$2,000
Boonton 82AD, Modulation Meter	\$450	HP 8901A, Modulation Analyzer \$1,000
Boonton 92BD, Digital RF Millivolt Meter	\$250	HP 8903B, Audio Analyzer, Opt. 001 \$2,000
Boonton 2500, DC Range Calibrator	\$250	HP 8920D, Dual-Mode Cellular Mobile Test System
Boonton 4G, Power Meter Sensor, .01-26.5GHz	\$200	Opt. 002,008,014
Boonton 4200, Power Meter w/4G Sensor, Cable	\$500	HP E3617A, DC Power Supply, 0-40V, 1A
Bruel & Kjaer 1612, Bandpass Filter	\$250	HP P486A, Power Sensor, 12.4-18GHz
Calif. Inst. 101T, AC Power Source	\$200	Hushae 8010H TWT Amplifer 2.9CHz et 000
EIP 371, Source Locking Microwave Counter, 18GHz	. \$1,000	Huntron 51000S Computer Controlled Troubleshooting
EIP 545A, Microwave Counter, 18GHz, Opt. 02,05,08	. \$1,000	System
EIP 578, Source Locking Microwave Counter, 26.5GHz. EIP 931, Microwave Source, .01-18.6GHz, Opt. 9320	\$5,000	Keithley 192, Programmable DMM, 6.5 Digits, HPIB \$600
ESI 296, Auto LCR Meter	\$800	Keithley 195A, Digital Multimeter
Fluke 515A, Portable Calibrator	\$800	Keithley 614, Electrometer
Fluke 5450A, Programmable Resistance Calibrator	. \$1,000	Krohn-Hite 3202, Filter, LP, HP, BP, Unused\$350
Fluke 6010A, Frequency Synthesizer, 10Hz-11MHz	\$300	Leeds & North 1091, Capacitor Decade, .001uF-1uF \$150
Fluke 8520A. Digital Multimeter	\$250	Micronetics NSI-52640W, Noise Source, 26.5-40GHz \$350
Fluke 8922A, True RMSVoltmeter	\$250	Micro Sciences ICI-101, IC lester
Fluke A55, Thermal Converter  General Microwaya 4784, Pank Power Meter	\$200	Ning H1-21, Handy IC Tester
General Radio 1557, Vibration Calibrator	\$400	Narria 5202 Directional Counter 1-19CHz 6200
Gigatronics 600/6-12, Frequency Synthesizer	. \$1,000	Racal Dana 1515. Delay Pulse Generator \$500
Opt. 03/06	. \$8,000	Racal Dana 1992, Frequency Counter, High Stab \$500
Guildline 9154C, Transvolt Standard Cell	\$300	Simco A300, Aerostat Anti-static
Guildine 9577, Precision DMM, 7.5 Digits	\$300	Sorensen DCS-33-33, Power Supply, 0-13 volts
HP 1122A, Probe Power Supply	\$200	0-33 Amps\$500
HP 11590A, Bias Network	\$250	Tek 134, Probe Amplifier for P6021 & P6022
HP 11605A, Flexible Arm	\$100	Tek 14/0, NTSC Color Sync & Test Sig. Generator \$500
HP 11638A, Calibration Kit, Type N	\$600	Tak 1502/0, TDH
HP 11869A, Adaptor for Plun-In 8350A/R	\$250	Keithley 192, Programmable DMM, 8.5 Digits, HPIB \$600 Keithley 15A, Digital Multimeter \$300 Keithley 1614, Electrometer \$700 Krohn-Hite 3202, Filter, LP, HP, BP, Unused \$350 Leeds & North 1091, Capacitor Decade, "001µF-1uF \$150 Micron Sciences ICT-101, IC Tester \$350 Micro Sciences ICT-101, IC Tester \$300 Ming HT-21, Handy IC Tester \$300 Ming HT-21, Handy IC Tester \$100 Narda 5082, High Directivity Bridge, 2-18GHz \$300 Narda 5082, High Directivity Bridge, 2-18GHz \$300 Narda 5082, High Directivity Bridge, 2-18GHz \$300 Narda 5292 Directional Coupler, 1-18GHz \$200 Racal Dana 1515, Delay Pulse Generator \$500 Racal Dana 1992, Frequency Counter, High Stab. \$500 Simco A300, Aerostat Anti-static \$100 Sorensen DCS-33-33, Power Supply, 0-13 volts 0-33 Amps \$500 Tek 134, Probe Amplifier for P6021 & P6022 \$100 Tek 134, Probe Amplifier for P6021 & P6022 \$100 Tek 15030, 1/05, TDR, Scale in Meters \$1,000 Tek 15030, TDR with Opt. 03, Battery Pack \$2,400 Tek 178, Linear IC Test Fixture, For 577 \$150 Tek 2245A, Scope, 100MHz, 4 Channels \$900 Tek 2445A, Scope, 100MHz, 4 Channels \$1,200 Tek 2445A, Scope, 150MHz, 4 Channel \$1,200 Tek 2445A, Scope, 150MHz, 4 Channel \$1,200 Tek 2445A, Scope, 150MHz, 4 Trace, HPIB \$1,500 Tek 318, Logic Analyzer w/accessories \$500 Tek 318, Logic Analyzer w/accessories \$500 Tek 318, Logic Analyzer w/accessories \$500 Tek 338, Logic Analyzer w/accessories \$500 Tek 338, Logic Analyzer w/accessories \$500
HP 11970A, Harmonic Mixer, 26.5-40GHz	\$600	Tek 178 Linear IC Test Fixture For 577 \$150
HP 11970K, Harmonic Mixer, 18-26.5GHz	\$600	Tek 2245A, Scope, 100MHz, 4 Channels \$800
HP 1630D, Logic Analyzer w/pods	. \$500	Tek 2246, Oscilloscope, 4-Channel, 100MHz, Cursors \$1,200
HP 1630G, Logic Analyzer, 65 Channels	\$500	Tek 2432, Scope, Digital, 300MHz, 4 Channel, HPIB \$2,000
HP 16530A/16531A, Digital Scope Card,	\$500	Tek 2445A, Scope, 150MHz, 4 Channel
HP 214B, Pulse Generator	. \$1,000	Tek 2445B, Scope, 150MHz, 4 Trace, HPIB\$1,500
HP 33102A, Microwave Switch, 100MHz-18GHz	\$100	Tek 2465, Scope, 300MHz, 4 Channel
HP 3325A, Function Generator, Opt. 601	\$1,000	Tek 305DMM, Scope, 10MHz, Dual Trace, DMM, battery \$500
HP 3325A/01/02, Function Gen., Opt. 01/02	. \$1,500	Tek 318, Logic Analyzer w/accessories
HP 33322H, Programmable Attenuator, DC-18GHz HP 3336C, Synthesizer Level Generator, Oct 005	\$1,000	Tak 338 Logic Analyzer widocessures
HP 3400A, RMS Voltmeter, 10Hz-10MHz	\$100	Tek 464. Scope, 100MHz Dual Trace, Storage
HP 3403C, True RMS Voltmeter	\$200	Tek 492, Spectrum Analyzer, Opt. 01/02
HP 3468A, Multimeter, 5.5 Digits	\$200	Tek 492/02, Spectrum Analyzer\$4,000
HP 35689A, S-Parameter Test Set for 3589A	. \$1,400	Tek 318, Logic Analyzer w/accessories         \$500           Tek 338, Logic Analyzer.         \$400           Tek 484, Scope, 100MHz Dual Trace, Storage         \$400           Tek 492, Spectrum Analyzer, Opt. 01/02         \$4,500           Tek 492/DZ, Spectrum Analyzer         \$4,500           Tek 492/BP, Spectrum Analyzer         \$8,500           Tek 492P, Spectrum Analyzer, Opt. 01,02         \$5,000           Tek 576, Curve Tracer         \$1,800           Tek 577, Curve Tracer w/177 Fixture         \$1,000
HP 4140B. Picoammeter, DC Source	\$2,000	Tek 492P, Spectrum Analyzer, Opt. 01,02
HP 4274A, Multi-frequency LCR Meter, Opt. 001,002,003	3	Tek 576, Curve Tracer\$1,800
HPIB, includes Test Fixture	\$2,000	Tek 577, Curve Tracer w/177 Fixture \$1,000 Tek 604, XY Monitor \$100 Tek 7020, Programmable Digitizer PI \$600 Tek 7020, Programmable Digitizer PI \$600 Tek 7511, Sampling Unit w/S Head, DC-14GHz \$600 Tek A610, Current Probe, 2-500 Amps \$200 Tek DC503, Universal Counter Timer TM500 \$100 Tek DC504, Counter/Timer TM500 \$100 Tek DM502A, Autoranging DMM \$150 Tek DG504 Function Generator 1MHz \$100
HP 435B, Power Meter	. \$350	Tek 2000 Present and Printers St.
HP 436A/022, Power Meter, HPIB	\$500	Tek 7511 Sampling Unit w/S4 Head DC-14GHz \$800
HP 5006A, Signature Multimeter	\$300	Tek A610, Current Probe, 2-500 Amps
HP 5334A/020, Universal Counter w/DVM	\$600	Tek DC503, Universal Counter Timer TM500 \$100
HP 5335A/030. Frequency Counter. 1300MHz	\$800	Tek DC504, Counter/Timer TM500\$100
HP 5340A, Frequency Counter, 18GHz	\$600	Tek DM502A, Autoranging DMM\$150
HP 5340A, Frequency Counter w/Opt. 01/02/011	\$800	Tek FG501, Function Generator, 1MHz \$100
HP 5345A, Frequency Counter, Opt. 012	. \$400	Tek FG502, Function Generator, .1Hz-11MHz \$250
HP 5350A/010/002, Microwave Frequency Counter	. \$2,000	Tek P6046, Differential Probe
HP 54200A, Digital Storage Scope	. \$800	Tek P6202A, FET Probe, 500MHz unused
HP 54601A, Digital Scope, 100MHz, 4 Channel	. \$1,200	Tek P6602, Temperature Probe for DM5110, DM511 \$150
HP 5340A, Frequency Counter, 183472. HP 5340A, Frequency Counter wCpt. 01/02/011. HP 5342A, Microwave Counter. HP 5342A, Frequency Counter. HP 5345A, Frequency Counter. HP 5350A/010/002, Microwave Frequency Counter. HP 54100D, Digital Scope, 105Hz. HP 5420A, Digital Scope, 106Hz, 4 Channel. HP 5401A, Digital Scope, 100HHz, 4 Channel. HP 6112A, Power Supply, 0-40V, 0.5A. HP 8015A, Pulse Generator, 1Hz-50MHz, 30V HP 8165A, Programmable Stanal Source.	. \$500	Tek PG506, Scope Cal System w/TG501, SG503,
HP 8165A, Programmable Signal Source, Opt. 02/03	. \$1,000	Tek PG508, Pulse Generator, 50MHz\$300
HP 8350A, Sweep Oscillator Mainframe	. \$1,000	Tek PS503A, Dual Power Supply
HP 8350B, Sweep Oscillator Mainframe	\$1,500	Tek SC502, Scope, 15MHz, Dual Trace
HP 83540A, RF Plug-In, 2-8.4GHz	\$1,200	Tek SG502, Sig. Gen. 5Hz-50KHz
HP 8410C/8412B, Network Analyzer	2000	Tek TDS410, Digitizing Oscilloscope, 150MHz, Opt. 13,1F \$3,000
HP 8411A, Frequency Converters	. \$250	Tek TM503, 3 Slot Power Module\$100
HP 8410C/8412B, Network Analyzer w/8411A/Opt. 18, 18GHz HP 8411A, Frequency Converters HP 8414A, Polar Display HP 8444A, Tracking Generator. HP 8445B, Spectrum Anyz., Automatic Pre-Selector HP 8447E, Amplifler, 1-1300MHz, Gain 22dB HP 8501A, Storage Normalizer, w/cable. HP 8503C, 3.5mm Calibration Kit HP 8505A, Network Anyz. w/8501A & 8503A, Opt. 05 HP 8505B, Directional Bridge. 10MHz-26.5GHz	\$100	Tek WM490A, Waveguide Mixer, 26.5-40GHz\$800
HP 8444A, Iracking Generator	\$300	Tek WM490K, Waveguide Mixer, 18-26.5GHz
HP 8447E, Amplifier, .1-1300MHz, Gain 22dB	\$600	Texscan SSG2000, Freq. Syn., 100KHz-2GHz,
HP 8501A, Storage Normalizer, w/cable	\$800	AM, FM\$1,800
HP 8505A, Network Arryz, w/8501A & 8503A, Opt. 05	. \$4,000	Ungar 4624, Solder, Desolder Station \$250
		Vu-Data 5110, Semiconductor Tester, In/out Circuit \$150
HP 8557A, Spectrum Analyzer, .01-350MHz HP 8558B, Spectrum Analyzer, .1-1500MHz HP 8559A, Spectrum Analyzer, .01-21GHz	. \$1,300	Wavetek 178, 50MHz Programmable Waveform Syn \$1,000 Wavetek 180, Sweep/Function Generator \$200
HP 8559A, Spectrum Analyzer, .01-21GHz	. \$2,000	Wavetek 185, Sweep Function Gen0001-5MHz \$400
HP 8559A/853A, Spectrum Analyzer, Digital, .01-21GHz		Wavetek 1084, Signal Gen. Sweeper, 3.5-4.5GHz \$300
HP 8565A, Spectrum Analyzer, .01-22GHz, Opt. 100	. \$3,000	Wavetek 1910, XY Monitor, Dual Trace\$400
HP 8569A, Spectrum Analyzer, 10MHz-22GHz	. \$5,000	Wavetek 452, Filter, Dual Hi/Lo, 1Hz-10KHz \$450
HP 86241A, RF Plug-In, 3.2-6.5GHz	\$400	Wavetek 907, Signal Generator, 7-11GHz
HP 86260A, RF Plug-In, 12.4-18GHz	\$400	Wiltron 560-7K50, RF Detector, 10MHz-40GHz \$400
HP 86290B, RF Pluo-In. 2-18GHz	\$1,400	Wiltron 610D, Sweeper Mainframe
HP 8643A, Synthesized Frequency Generator	. \$6,000	Wiltron 6213D, RF Plug-In, 10MHz-4.2GHz
HP 86601A, RF Plug-In, 110MHz.	\$2,500	Wiltron 6223D, RF Plug-In, 4-12.4GHz\$250
HP 86602A, RF Plug-In, 1300MHz.	\$500	Wiltron 6229D, RF Plug-In, 7.9-18.5GHz
HP 8672A, Frequency Synthesizer, 2-18GHz	\$4,500	Wiltron 62FF75, VSWR Bridge, 10-1000MHz\$150
HP 8569A, Spectrum Analyzer, 10MHz-22GHz HP 86220A, RF Plug-In, 10-1300MHz HP 86220A, RF Plug-In, 10-1300MHz HP 86260A, RF Plug-In, 12.4-18GHz HP 86260A, RF Plug-In, 2-18GHz HP 86290B, RF Plug-In, 2-18GHz HP 86290B, RF Plug-In, 2-18GHz HP 8643A, Synthesized Frequency Generator HP 8660C, Freq Syn W86603A & 86835A, 2.6GHz HP 86601A, RF Plug-In, 110MHz HP 86603A, RF Plug-In, 1300MHz HP 8670A, RF Plug-In, 2600MHz HP 8670A, Frequency Synthesizer, 2-18GHz HP 8670A, RF Plug-In, 26.5-40GHz HP 8743A, Reflection Transmission Test Set	\$250	Wiltron 6NF50, Autotester, 1-1500MHz, for 640 \$100
HP 8743A, Reflection Transmission Test Set	\$200	Wiltron 7B50, Detector, 1-1500MHz, for 640\$100

# MONTHLY CLEARANCE SALE





#### PHELPS INSTRUMENTS

2631 Hillside Ave., Norco, CA 91760 909-279-7347 • FAX 909-279-7323



The design kit SGM5800KS is a complete and immediately usable means of avaluating the SIGEM GPS receiver modu and high performance GPS antenna, which are included in and many periodizance GPG animetrial, wind: at included in the kill. Software running on the GPS receiver module communicates to a user supplied computer via NMEA 0183 formatted messages. Advanced PC software provides map integration and a demonstration of tracking. Provision has been made for DGPS inputs.

SIGEM Inc. Canada K2K 2M5 Tet: (613) 271-1601 (Can) (541) 923-3733 (USA)

Fax: (613) 271-1896

SiGEM

#### SINGLE SIDED **PCBS**

9 C PER SQIN, \$100 SET UP, SMOBC, ONE OUNCE COPPER,PC75, 1/16", ONE SOLDER MASK AND ONE SILK SCREEN. PHOTO PLOT \$ 50

# DOUBLE SIDED

**PCBs** 14 ¢ PER SQIN, \$150 SET UP, PTH, ONE OUNCE COPPER, FR4, 1/16", TWO SOLDER MASKS AND ONE SILK SCREEN. PHOTO PLOT \$ 75.

14¢

PLEASE VISIT OUR WEB SITE FOR MORE

WWW.VANDVMACHY.COM

V&V MACHY & EQUIP. INC PH. (281) 397 6220

MARKETING TECH S.A. PH. 011 525 361 3351, FAX. 011 525 361 5996

# SBC2000-074 RS-232 BASIC LCD DIO A/D Keypad Versatility starting at \$64 each.

Voice: 303.422.8088 Fax: 303.422.9800

w.sbc2000.com Westa Technology, Inc.



2 Audio Inputs may be used for digital data Customizations including battery packs and Special Frequencies

Matco Inc.

(800)440-0299 or (800)719-9605 www.mat-co.com

#### Telecom Hardware/Software Developers

STOP using your phone lines to test and demonstrate our telecom devices. Our affordable telephone line simulators offer authentic USA dial tone, busy signals, ringing, and exceptional speech quality.



RING-IT! TELCO SIMULATOR

- Single Line (two RJ-11 Jacks)
   LED Display
   DTMF Operation
- Automatic Ring-up Mode
   \$325 (\$149 kit available)

PARTY-UNE

PARTY-LINE TELCO SIMULATOR

- Six Extensions
- Caller-ID (Name/Nbr)
- Distinctive Ringing \$425 (\$199.95 kit



COMPANY

134 Windstar Circle Folsom, CA 95630 USA Tel: 916-985-7219

Digital Products

VISA Fax: 916-985-8460

http://www.digitalproductsco.com

#### LCD Terminal \$99



LCD 240 x 64 EL Backlit RS-232 Port

1200 Baud Modem

8051 Compatible Microcontroller 192k Low Power Static Memory Infared Transmitter

Nicad Battery Pack QWERTY Keyboard FM SCA Data Receiver

Junkware.com

http://www.junkware.com

#### PC BOARD SERVICES

PCB Design Layout Thru Hole SMT

Multilayer PCB FABRICATION

In-house Prototypes Single and Double Side Plate Thru Hole

**ASSEMBLY** 

Thru Hole Small Project Specialists

Serving Engineers and Hobbyists for 16 Years

> MIDLAND TECHNOLOGIES 800-726-8871 Voice 406-586-0300 FAX

#### PCB's in Minutes From LaserPrint!\*

8 1/2" x 11" Sheets

iron to apply 1339 n-Peel

Casy Hobby Quality PCB's

Transfers Loser Printer

#### POP BLUE - POP WET For High Precision fessional PCB Layouts

- 1. LoserPrint

Adds on Extra Layer of

Rdds an Extra Layer of Resist for Super Fine Innes on Std Clad Bds Resist to Std Gad Bds Resist to Std Gad Bds 20Sh\$30/40Sh\$50/100Sh\$100 Blue/Wet (No Mix) Sample Pack 5 Shts Blue + 5 Shts Wet \$20 VISP/MC/PO/CK/MO \$4 S6H - 2nd Day Mail Techniks Inc. P.O. Box 463 Ringoes NJ 08551 (908)788-8249

#### Serial Port Problems???

No heavy, aging serial protocol analyzer available? Use Serial to turn your PC into a test tool for asynchronous serial communications. Serial uses your PC serial ports to capture data, control and time stamps to give you what's needed to develop or debug your serial communications.

- Captures Data & Control lines

- Millisecond Timir Extensive Manual
- Contextual Help Block Transmit \* Trigger Strings Autobaud Detect

Serial with manual

US\$99.00

Full Duplex monitor cable

US\$40.00 Allison Technology Corporation

2006 Finney Vallet Rd., Rosenberg, TX 77471 800-980-9806 or 281-239-8500, Fax: 281-239-8006 http://www.atcweb.com atc@accesscomm.net

#### New! ActiveWire™USB Simple USB Interface INTERNITER FILLIAND



- 24 MHz CPU core with USB Firmware downloadable via USB
- 16 bit parallel I/O Expandable add-on boards
- New firmware and scripts available from website

\$59 plus shipping ActiveWire, Inc.

www.activewireinc.com fx(650) 493-2200 nh(650) 493-8700

# **QUALITY KITS**

#### **#1 Source for Electronic Kits**

Great selection of Hi-Fi AUDIO Kits, PSUs, Transmitters, Oscilloscopes, PIC Programmers, and much more.

Toll Free Order Line: 1-888-464-5487

Secure On-Line Ordering www.gkits.com

Call 613-544-6333 for free catalog **North American Kit Distributor** 49 McMichael St., Kingston, ON K7M 1M8, CANADA

#### Convert RS-232 to RS-485 or TTL/CMOS for Only \$49.00



#### COMMUNICATIONS CONVERTER

- FULL SCHEMATIC AND DOCUMENTATION
   FULL FAMILY OF MODULAR DESIGNS
- RS-485/RS-422 REMOTE I/O MODULE KITS
- NETWORK SOFTWARE AND SOURCE CODE AUTOMATIC OR RTS UNITS AVAILABLE
- RJ-11/12 CONNECTORS OR TERMINAL STRIP TURN YOUR PC INTO A DISTRIBUTED DATA ACQUISITION AND CONTROL SYSTEM

# R.E. SMITH

(513) 874-4796 4311 TYLERSVILLE RD. 

+ HAMILTON, OHIO 45011 WWW.rs485.com

#### **Program PICs in Basic** Complete kits to get started!



Includes: PIC Basic Compiler, EPIC Programmer, 16F84 PIC, Cable & Batteries



**Electronic Products** www.elproducts.com

# PRINT to VIDEO!

Tiny BOB-II module superimposes up to 308 characters on NTSC/PAL video or generates video automatically. Fast 2.4~19.2kbps RS-232 serial interface. Simple to control; like a printer. Many powerful applications:

**Home Automation - MATV Video Inspection & Testing** Surveillance - CCTV - ATV **Remotely Piloted Vehicles** Gaming - Racing - Sports Process/Experiment Monitor **Robotics - Electronic Signs** 

#### BOB-II-NTSC only \$79.95

#### **DECADE ENGINEERING**



5504 ValView Dr. SE, Turner, OR 97392 Tel: 503.743.3194 - Fax: 503.743.2095

#### Globaltech Distributors THE ULTIMATE ELECTRONIC SAVING STORE

Wholesale Prices Available--- Don't Miss-Out Call Today!---1-(800)582-5116

Computer Acc. Remote Controls Semiconductors IC's & Microprocessor Radios & Amplifiers Satellite Acc. Telephone Acc. **Anti-Tapping Devices** 

2-Way Radios

Recordable CD's Alkaline Batteries 4 Wire Harness Anti-Virus Prog. Soldering Stations Cellular Chargers Hearing Aids Laser Pointers Power Supplies

\*Free Internet Service - Free Color Catalog

Buy Direct Buy Today

Order@globaltechdistributors.com

& Save

00000



ALL ALUMINUM CONSTRUCTION

FER GOOD ONLY IN THE 48 STATES. ENDS DECEMBER 20, 1999. LIMIT O
DUEST PER CUSTOMER, MAILED 15T CLASS, ALLOW 1-2 WEEKS FOR DELIVERY.



ORDERS 800-634-3457 • FAX 800-551-274 OFFICE 702-565-3400 • FAX 702-565-482 SESCOM, INC. 2 SESCOM, INC.



#### CIRCUIT CHEM, INC.

#### \*PROTOTYPE TO PRODUCTION

SIDED: 5-days, 10 Pcs. \$275.00 D/SIDED: 5-days, 5 Pcs. D/SIDED: 5-days, 10 Pcs. \$300.00 \$350.00 4-LAYERS: 5-days, 5 Pcs. \$750.00 4-LAYERS: 7-days, 10 Pcs. \$850.00 6-LAYERS: 5-days, 5 Pcs. \$950.00 6-LAYERS: 7-days, 10 Pcs. \$1,175,00 (Up to 30 sq. inch each, includes Tooling)

\*SERVICES\* - UL Approved SMOBC, LP1 mask & Legend Photoplotting, Electrical Testing Thru hole/SMT, Gold/Nickel Plating Routing and Scored Panel, Instant Quotes

PH: (888) 427-2920, Fax (847) 427-1949 E-Mail: cir1920@aol.com

**LOWEST COST & FAST DELIVERY** 

#### **VIDEO PRODUCTS**







CNL-100 \$49

BX-120-P SX-800 \$79 \$59

- · 430 TV Lines Resolution
- 9-14 VDC Operation
- Infrared Sensitive
- SX-800 has Audio Output
- A-300 Camera Enclosure also available

#### MATCO, INC.

Schaumburg, IL 1-800-719-9605 • 1-847-619-0852 FAX E-Mail — info@mat-co.com Website — www.mat-co.com



Visit our Online Catalog www.mscelectronics.com

**MSC Electronics** 

BOX 461 Jessup, MD 20794 (301) 497-1600 FAX (301) 497-1925 No Checks • US & Canada Only

VISA



#### 8751 574000 574200 5C8A PIC16C56 PIC16C54 27C210 27C010 PIC16C622 GAL16V8 708 7C512-90 **GAL22V10** STATIC RAM PROCESSOR MEMORY D-RAMS HM628128 62256

Many more parts in stock
 All major brands
 All guaranteed

E-Mail: eproms@aol.com

TEL: (818) 774-9444 · FAX: (818) 774-0822 WE BUY EXCESS INVENTORY

**COVERT CATALOG2000** 

BRAND NEW!

The Latest, Up-to-date, Hands-on Supplier and Source Guide for:

■ Electronic surveillance equipment

Counter measures gear

Electronic tracking systems

Entry supplies

Covert video cameras and transmitters

Computer surveillance and remote viewing

dmdsystems.com

[electronic test & mfg]

[test]

[measurement]

[rf/microwave]



# ANTIQUE RADIO CLASSIFIED

Antique Radio's Leading Monthly Magazine

- Classifieds - Ads for Parts & Services. Also: Ham Equip. - Books -Telegraph - 40's, 50's & 60's Radios -Early TV - Auction Reports & more...

1-Year: \$39.49 (\$57.95 by 1st Class) 6-Month Trial - \$19.95. Foreign - Write.

A.R.C., P.O. Box 802-G23

Carlisle, MA 01741 Call: 978-371-0512 - Fax: 978-371-7129 Web: www.antiqueradio.com

# TOGGLE SWITCHES — All sizes and types Commercial Quality

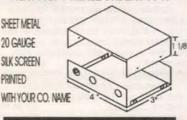
			0.000		
FULL SI	ZE TOGGLE	SW. 1/2" DI/		P	RICE
TYPE				100-1	1000
SPST	D125	6A/125V	6" wire	.77	.67
SPST	D128	4A/125V	Solder	.57	.47
DPDT	D126	5A/125V	Solder	.77	.67
DPDT	D127	10A/125V	Solder	1.17	
on-off	on	5A/250V			
	MINIATURE	TOGGLE SW		" DIA.	
SPST	D131		Solder		
	D132		Solder		
	D129	6A/125V			
	off-mom				
					.67
on-off	D134	3A/250V	Solder		
	D133	6A/125V	Solder	.77	.67
DPDT	D135	6A/125V	Solder	.92	.82
on-off	-on				
DPDT	D130	6A/125V	Solder	.92	.82
		3A/250V			
		USHBUTTON		1/4" D	IA.
COCT NA	or Open DM	26/125V	Solder	37	77

SPST Nor Close DM2 3A/125V Solder .32 .27 ANY ORDERS LESS THAN 100, ADD 20¢ EACH LEDs Red, Yellow, Green — \$12.00/100 \$10.00/1,000

DEMAR ELECTRONICS P.O. Box 7215, Algonquin, IL 60102 Toll Free 877-655-6433 Fax 847-854-4434

# CABLE BOXES

CUT MANUFACTURING COST! WE ACCEPT SMALL ORDERS TOO.



#### ALSO PCB. SMT. PROTOTYPES, ASSEMBLY PLASTIC MOLDS, INJECTION MOLDING

USA Office: V&V Mach. & Equipment, Inc. Ph: (281) 397-8101, Fax: (281) 397-6220. Mexico Plant: Marketing Tech. (525) 361-3351, Fax: 011 (525) 361-5996. PLEASE VISIT OUR SITE

Equipment, exact addresses and ordering info from 15 countries!! 220 pages - \$39.95 II 3555 S El Camino Real, San Mateo, CA 94403

MODEL 40

Phone 650-513-5549 = fax 650-728-0525 or www.intelligence.to (no "dot com") WWW.VANDVMACHY.COM

### **ASSEMBLY &** ENGINEERING

Producible designs since 1970 **Contract Engineering** 

Embedded Microprocessors PCB Layout and Packaging Design Analog Including RF to 1 GHz Instrumentation A/D and D/A

Contract Assembly

High-Speed Fuji Surface Mount Through hole Turn-key or Kit Run sizes one through thousands

Test and burn-in available Bilocon Corp. 800-736-5927 425-353-2276 www.bilocon.com

Stereo Microscopes for Large PC boards



9 in. arm for Large boards -10X & 30X -Dust cover -Eye guards -5 year warranty ST 231P-\$395.00



#### CONTROL · MEASURE · INPUT

#### MODEL 40-\$109

- RS-232 interface
- 28 lines digital I/O Eight analog inputs
- PWM output

#### MODEL 100-\$279

- 12-bit 100KHz A/D · Four analog outputs
   Three timer counters · 24 digital I/O



# PRAIRIE DIGITAL, INC.

920 SEVENTEENTH ST., INDUSTRIAL PARK PRAIRIE DU SAC. WI 53578 TEL: (608) 643-8599 · FAX: (608) 643-6754

# ASTRO TOO

Surplus/Electronics Equipment

Web Site: AstroToo.Com E-Mail: Astro@AstroToo.Com

2854 Sarno Road Melbourne, FL 32935

(407) 253-3371 Fax: (407) 727-1546

When visiting Central Florida, come see us! 1-95, Exit 72

#### GRADE "A" CD RECORDABLE DISKS DIAMONDBACK CD-R

DISK TYPE	QTY	EA	SPINDLE
74 Min. 650MB			\$79.00
(on spindle)	100	.79	Silver/Silver
80 Min. 700MB			\$129.00
(on spindle)	100	\$1.29	Silver/Blue

- Excellent for Music and Data Integrity
- Reliable OEM Quality

Call Toll Free 1-(888) 967-8400

RISK FREE DISKS, INC.

- OUR 20TH YEAR www.riskfreedisks.com







# softwarecloseouts.com

DOS - Windows - Win95 **UNIX - MAC - Upgrades** Secure on-line ordering

#### softwarecloseouts.com

Corel Office 7 \$29 Norton Anti-Virus 2 \$5 Windows WGP 3.11 \$39 Office 4.2upg \$39 Up to 85% off titles by Symantec!

#### softwarecloseouts.com

**New Arrivals Weekly!** Hard-to-find a specialty ... We buy your surplus software.

softwarecloseouts.com







nonfunctional ...

800-255-5545

... Please call

Heavy Duty Surge Suppressor Plug Strips, 6 outlet, circuit breaker, Case of 25 in individual boxes..\$50/case

HP Power Supplies, HP6260B current is 0-50A, . ...\$100 UPS, 250va to 3 kva, functional and

Power Conditioners, Oneac, TLC, Teal, Sola, various sizes ...... Please call

BMI, Dranetz, and RPM Power Quality Monitors...

www.powerqualityinc.com

# SURPLUS



12VDC/200MA .... CS033 .... \$0.99 13.5VAC/400MA.. CR574 .... \$1.29 24VDC/500MA .... CR174 .... \$3.40

Min 1000/type -- Call for other types

#### **SURPLUS TRADERS**

PO Box 276, Alburg, VT 05440 Tel: (01) 514-739-9328 Fax: (01) 514-345-8303 http://www.73.com/w

FREE CATALOG!

### PROGRAMMERS



629 ICE TECH MICROLV 650 EETOOLS ALLMAX + 409 EETOOLS MEGAMAX 509 EETOOLS MEGAMAX4

369 XELTEK SUPERPRO II







795 CHROMA SIMM/SIP 359 MOD-MCT-EMUPA/R 279 MOD-MCT-EMUP/R

69 EPROM 1G TO 1MEG 99 EPROM 4G TO 1MEG 199 EPROM 16G TO 1 MEG 89 EPROM 1G TO 8MEG 409 XELTEK SUPERPRO II P 249 XELTEX SUPERPRO L 165 XELTEK ROMMASTER II 479 MOD-MCT-EMUPA 739 STAG ORBIT-32 250 EPROM 8G TO 8MEG



LABTOOL48 MICROMASTER

#### **General Device Instruments**

Sales 916-393-1655 Fax 916-392-4949

Aventrade 4518 Temple City Blvd., Temple City, CA 91780 Tel. 626-286-0118 Fax 626-287-9618 E-Mail: sales@aventrade.com

BATTERY — YUASA

Sealed Lead-Acid/Gel-Cell

12V: 7AH \$19, 2.3/4AH \$16 18AH \$39, 1.2AH \$13

6V: 4AH \$9, 10AH \$13

Quantity Discounts Available

Call for other models

### CUSTOM PLASTIC PARTS

- MODELS (WOOD AND RESIN). TO EVALUATE YOUR PARTS BEFORE



\*PRODUCTION OF INJECTION MOLDED

BIG.

VERY COMPETITIVE
ON HIGH LABOR
PARTS.

We also have manual low pressure machines for injection molding of very small runs or prototypes of parts up to 2 oz. At a surprisingly low price USA. Office: V&V Mach.&Equip Inc.
Tel (281) 397-8101, Fax (281) 397-6220.

Tel. \*Edo. de Mexico 54040 \*Tel. 011 (525) 361-3351.

Tal. \*Edo. de Mexico 54040 \*Tel. 011 (525) 361-3351.

Fax 011(525) 361-5996. ATTN: VICTOR M.MENDOZA e-mail. marklech@infosel.net.mx

PLEASE VISIT OUR SITE WWW.VANDVMANCHY.COM

#### JUNE SPECIAL SAVE \$10.00, SHIELDED LOOP RECEIVER 30M 40M KITS W/ ANTENNA VERY SENSITIVE. HAS HIGH MMUNITY TO ORN & LOCAL AM BROADCAST. \$92.50 PP

12/14V PULSE BATTERY TESTER (LEAD ACID). ATTACH THE BATTERY & PUSH THE BUTTON TO DETERMINE IF THE BATTERY NEEDS RECHARGING. A MUST FOR THE GLIDDER SET, BOATERS, ETC.

ASSEMBLED WITH ENCLOSURE \$106.50 PP MARCONI ANTENNA 700W 50 Q THE BEST "LITTLE" LOW BAND ANTENNA \$47.45 PP 80M: 67' OVERALL 160M: 130' OVERALL

CODE PRACTICE OSCILLATOR... \$23.45 PP SEND FOR FREE CATALOG 1-800 JADE PRO (523-3776) www.jadeprod.com/

email: jadepro@jadeprod.com

JADE PRODUCTS E. HAMPSTEAD NH 03826-0368

#### **CABLE SECRETS!!!**

This ad has been

#### CENSORED!

Want to know why? Want to know why?
Visit us at http://www.worldwyde.com
Find out how "Test" Devices work
Installation of "Test" Devices
Descrambling Methods Explained
Detailed Construction of "Test" Devices

Includes plans and source code

Complete source code ...... \$79.95 Code for individual boxes ....... \$29.95

# DSS SECRETS — Vol. 2

Instructions on programming DSS access cards. This is the most current information on the market! Includes software, plans, and hardware sources. Book & CD-ROM.

Get this before they censor it too!!! DSS Secrets Vol. 2 ...... \$49.95

VISA • MasterCard • AmericanExpress To order, call Worldwyde © 1-800-773-6698 21365 Randall Street • Farmington Hills, MI 48336 Visit us on the web at www.worldwyde.com

#### Sensors and Real Time Clocks



AT6 Digital Inclinometer kit

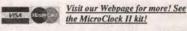
A2-axis measure of variation from the level position

AFor robots, vehicles, more!

ARclative Humidity &
Temperature Sensor

ASends data over 100 feet

A\$64.95+ ship/handling



▲\$59.95+ ship/handling

Technology Electronics, Ltd.

Phone: 937-438-4683 Fax: 937-438-5934 www.technologykit.com kits@technologykit.com

#### TV 85 PJ & TV 86 CABLE CONVERTERS **VOLUME &** NON-VOLUME CONTROL

SALES/SERVICE VOICE 1-800-473-0506 FAX 1-800-488-0525

#### **FOSS** WAREHOUSE DISTRIBUTORS

285 Schenck St. N. Tonawanda, NY 14120 www.fossw.com

Continued from page 77 of BASIC

So, to run your BASIC A program, which was most likely NOT saved in ASCII, you must leave Windows and get into DOS, and you must have a copy of GREASILY, widely available from old-timers.

Also, your BASIC A program is probably on a 5.25-inch floppy, so you'll need to find a machine with 5.25-inch and 3.25-inch floppies to have someone make a copy of the program onto a 3.25-inch diskette for use in most machines today that do not include 5.25-inch disk drives. Then it's just a matter of loading in GREASILY and using standard BASIC commands.

Fred Blechman West Hills, CA

#### TECH FORUM

#### ANSWERS TO #9994 - SEPT. 1999

The reason IBM BASIC A won't run on your (or anyone's) Windows machine is BASIC A requires "True Blue" IBM BIOS chips with "cassette BASIC."

Unfortunately, even today's "True Blue" IBM machines do not have "cassette BASIC" in their BIOS chips

All may not be lost, however, if you can locate someone who still has MS/PC-DOS versions packages prior to 4.0 (or you still have an old MS-DOS 3.2/3.3 package), get the program "GWBASIC.EXE." GWBASIC was IBM BASIC A with the "Required ROM Stuff" added so BASIC A programs can run on "clone" machines.

In my experience, GWBASIC will run 99% (or more) of BASIC A programs, and the programs it "won't run" only need minor coding changes (usually in single-line FOR..NEXT loops, IF..THEN statements, and some SCREEN function calls).

If you can't locate a GWBASIC source, look on your Windows install CD-ROM (or floppies) in the "OLD-DOS" (or "OLDMSDOS") folder for "QBASIC.EXE."

QBasic, which appeared with MS-DOS 5, was a stripped-down version of the once-popular Microsoft QuickBASIC 4.5 compiler. QBasic essentially replaced GWBASIC and is 99.9% compatible with programs written for BASIC A/GWBASIC (again, some "stubborn" programs need minor changes). The only "caveat" is you cannot compile your programs into "stand-alone" programs. NOTE: to get QBasic to properly run, you need to install the "QBA-SIC.EXE" ["interpreter"] and "QBA-SIC.HLP" (on-line HELP).

If you absolutely cannot locate either of these programs, E-Mail me at cloner@foxinternet.net and I'll be more than happy to send you one of them for your use.

Ken Simmons Auburn, WA

#### ANSWERS TO #9994 - SEPT. 1999

To run BASIC A on a Windows system, you can use the DOS Window. The following steps worked on my Windows 95 system.

Copy the two files BASICA.CMM and BASICA.EXE from your old DOS system onto a 3.5" floppy disk. At your Windows computer, select "Programs" and then "MSDOS prompt."

If you get the miniature DOS screen, enlarge it to full screen by using the "big window" button at the upper corner next the "X" button. Change to the root directory with the command CD . . " That's CD space period period. [DOS doesn't require the space in there, but it's good practice for when you convert to Linux.]

Make a subdirectory for BASIC A with the command MKDIR BASICA.

You can give it any name you like, but this one will help you remember what it's for. Now go to that new subdirectory with the command CD BASICA.

Copy both of the BASIC A files to your hard drive with the command COPY A:BAS\*.\*.

You will need to copy all of your ECALC files to this same subdirectory. The DOS Window is not really an exact copy of a real DOS system, so if you run into problems, then you should try the real DOS that also is available to you even on a Windows system. You get to it through the "Shutdown" menu.

Simply select the option "Restart your computer in DOS mode." That DOS should look very much like the system that your program is accustomed to. When you are done, return to Windows with the command EXIT.

If all comes to naught, then what you have is called a "project." You print out listings of ECALC, take out a clean sheet of paper, and convert it line by line to QBASIC. You may learn things you didn't even want to know.

BTW, if QBASIC is not already on your hard drive, you can find it on Windows CD-ROM at vour D:\OTHER\OLDMSDOS.

> **Jack Dennon** Warrenton, OR

Continued from Page 54

how it works and what else we can do with it.

#### How and Why

In the basic circuit (Figure 1A), the resistor limits the current through the LED to about 15mA, 0.015A. That assumes about 3.5 volts dropped

across the LED. It also allows for the battery to sag a bit with use. At no time will it allow too much current (more than 25mA) to flow through the LED.

#### **Electronic Switch**

In Figure 1B, we still have the same circuit, but we added a transistor and its bias resistor. The tran-

> sistor makes a good electronic switch. With the 33,000-ohm bias resistor, the transistor will have about 1.2mA base bias current. With a nominal current gain of 150-250, that much base current will saturate the transistor. It will turn the transistor on like an on/off switch. That will connect the LED and the resistor across the battery with only a slight loss in the transistor. It makes a good, but not a perfect switch.

A perfect switch would have zero volts lost across it. A voltmeter across this transistor switch showed 95mV, 0.095V across it. That makes it a practical, if not a perfect switch. The LED showed 3.48V across it with 10mA through it. At reduced current, the LEDs have somewhat less voltage across them.

#### Automatic, At Last

Add the switch and the photocell shown in Figure 1B and you have an automatic system. With SW2 closed, the system will respond to incident light. If the resistance from the base to the emitter goes low enough, the bias resistor will not be able to supply enough base current to keep the transistor turned "on." When the transistor turns off, so does the LED.

#### Photocells: A Crash Course

When light strikes the sensitive surface of either a phototransistor or a photoconductive cell, the resistance between the terminals decreases. The stronger the light, the lower the resistance. Depending upon the type of cell and the amount of light, the resistance can fall to a value as low as a few ohms. For our purposes, if it falls to something lower than about 4,000 ohms, the transistor in Figure 1B will not have enough base current and will turn off. That will turn off the LED.

As a practical consideration, the photocell will change resistance as the light level changes. A slow change in light level will cause a gradual change in collector current of the transistor thereby making the LED fade on or fade off. More complex circuitry would make the transistor and the LED snap on or off. The slow fade with its attendant higher voltage drop across the transistor will not harm it. That will also let us make a simpler circuit for an automatic light. We can make it turn on and off with sunset. sunrise, or we can turn it off when a room light turns on. It also makes the basis of a dandy science fair project. Details another time.

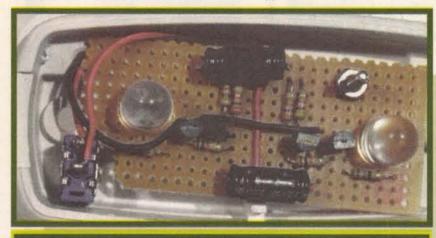
#### Pick a Package

Depending upon our need, we can package the white LED in a variety of ways. Pick the package that best suits your idea. Photo A shows the deluxe "pocket model." However, unless you are on close speaking terms with a lathe or with a machinist, you will probably go for something like the model in Photo C.

The idea of a bright white LED in a plastic rod caught the fancy of a good friend, Jim Haubert. He spends lots of time with a lathe. I let him. If you want details of how he made the holder, the on/off switch, etc., feel free to send him a note at haubert@casagrande.com. He can also give details of the somewhat easier to make model in Photo B. That one uses three "N" cells and a smaller current limit resistor. It will give a brighter light and still give decent battery life: about 50 hours. Figure 1A gives the circuit. DO remember the current limit resistor.

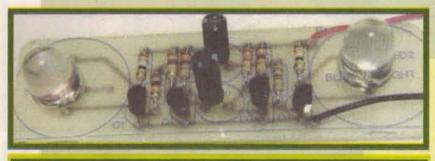
#### **Automatic Flashing Night LED**

Since my 'machine work' gives Jim and his asso-



#### PHOTO G

Backpack/Bike Light, Parts Placement Close-up of prototype board. Even if you do not get one of the boards from Far Circuits, the perfboard version gives excellent service. The oscillator transistors are on the inside of the board. The driver transistors sit next to their LEDs. A clip or a clamp goes on the back of the main assembly to hold it to a backpack or to a bike



#### PHOTO G1

Backpack/Bike Light, Parts Placement
Close-up of printed board from Far Circuits. The oscillator transistors
are on the inside of the board. The driver transistors sit next to their
LEDs. Quick, clean wiring with the PCB. Since the manufacturer
raised the allowable current for the LEDs, the 68 ohm resistors on this board were changed to 39 ohms.



#### SAFETREE HEAT SENSOR ALARM ORNAMENT

holiday ornament made by Quorum® is also a heat sensitive

holiday ornament made by Quorum@ is also a heat sensitive alarm that you can hang on your Christmas Tree. If there is a fire, the Safetree will emit a VERY LOUD (90 dBA per meter minimum) alarm when it detects a temperature above 122°F. The unit features very sophisticated IC and transistor circuity driving a loud Piezo Buzzer. The Safetree Heat Sensor Alarm Ornament operates 24 hours a day for 21 days on one 9-voit battery (not included). This attractive ornament is the perfect addition to your home for this holiday season. The ornament is silver in color and is about 2 1/2" in diameter, Brand new in manufacturer's box, complete with instructions. We are offering this unique holiday item at an extremely low price. Hurry and get yours today! price. Hurry and get yours today!

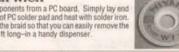
G9880 \$5.96.0a. Sale! \$2.95.0a. EVEREADY LONG LIFE

9V BATTERY



HANDY SOLDER WICK

Great for desoldering components from a PC board. Simply lay end of solder wick braid on top of PC solder pad and heat with solder iron. The solder "wicks up" into the braid so that you can easily remove the component. Brand new 5 tt long—in a handy dispenser.



\$1.29 ea.

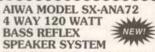
G1587

#### MAMMOTH 10MM 3 COLOR LED PACKAGE

Package of three 10mm diffused lens LEDs. You get 1 green, 1 yellow and 1 red. Each LED is similar except for the color. Great for making small fic lights. Prime, long leads

G1602

\$1.59/set



High quality stereo speaker system features two speakHigh quality stereo. Each speaker features 120 waits music
power rating, 6 ohms impedance (4 & 8 ohm compatbible), gray colored wood veneer cabinet with hi tech
AB5 face, sound pressure level of 87dB and size of 12"H x 9 1/2"W x 10 1/2" D. These are brand
new in a factory carton containing the 2 speakers. Weighs 25lbs. Hurry while supplies last.

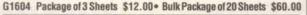
#### 12VDC 1.2AMP CHARGER ADAPTER

High power 12VDC adapter plugs into standard 120VAC outlet and puts out 12VDC at 1.2 amps. These do not have a built in filter capacitor, so if you need filtered supply, add a capacitor across the output. Brand new, compact tly 3 1/4" x 2 1/4" x 1 15/16". With 5mm barrel plug center (-).

G1566 \$3.49 ea.

1500ut 35VDC Radial filter capacitor for above 49¢ ea.

PRINT ON MAGNETIC PAPER This exciting new product allows you to create full color photo refrigerator magnets, notices, promotions, etc. with almost any inkjet printer. Let your imagination run wild as you perk up memos, create custom logo magnets, party notices, etc. After printing, simply cut with scissors. White matte finish sheet is about 8 1/4" x 11 3/4". This amazing product is for use with inkjet printers only in copy machines or laser printers.





CALLER ID BLOWOUT

These are used, good condition caller ID units with a large LCD display which shows name and phone # of caller (Unless blocked or out of area). Stores info on up to 72 callers. Operates on one 9V battery (not included). Call phone company to start caller ID service if you don't already have it. Hurry, don't miss out on this value!

G1550 SALE! \$2.00 ea.



For Phone Orders Call: 800-445-0697 or Fax Your Orders to: (602) 661-8259 For a Free Catalog Call: (602) 451-7454 Foreign catalog request: send \$5.00

Minimum Order: \$10 (plus min: \$5 Shipping and Handling). We accept MasterCard, Visa and personal checks, however, we cannot accept personal checks on orders outside the U.S. Minimum Foreign Order Amount: \$50 (plus a minimum \$10 S&H)



#### PARALLEL PRINTER CABLE

High quality 10ft long shielded bidirectional parallel printer cable (25 pin male to 35 pin centronics). These are brand new in retail pack-ages but we are selling them real cheap because they don't have the IEEE rating. Of course these cables were the highest standard just a few years and when the IEEE

available until just a few years ago when the IEEE was adopted, and we found that these cables

our print G1563 \$1.49 ea. • 10 for \$12.00 250/\$25.00

#### SUPER QUALITY **BLINDING OUTPUT** ded RED LED

Made for outdoor use, this clear lens T1 3/4 5mm jumbo LED pro-duces a brilliant red light that almost hurts your eyes to look at. High qual-ity LEDs made by Sharp!

G1599 8/\$1.00 Factory bag of

ciates a good laugh, I have to use the off-the-shelf boxes from the various parts outlets. Photo C shows the Automatic Night LED. Figure 1B gives the circuit

If you like to bike, hike, or camp, maybe you can think of a couple of uses for a blinking LED with automatic turn on and automatic turn off. Figure 2 gives the circuit for turning the basic, controlled-LED circuit into an automatic beacon, as seen in Photo E. The values shown work best for the white LED Later, we will see how to adjust just one value to make the circuit work for the lower voltage LEDs. Most likely, you can get the single color, jumbo LEDs easier than the small, white ones. Usually the single color LEDs cost less and lend themselves to many of these applications. Some of the suppliers, however, have started selling the white LEDs at competitive

#### What Makes It Tick

In Figure 2, Q3 is the same as Q1 in Figure 1B. It does the same thing and has close to the same values. In either circuit, when the base resistor, R5, in Figure 2 gets connected to the plus side of the battery, the transistor turns on the LED. In Figure 2, the base resistor connects to the cold side of R4 and to the collector of Q2. When Q2 is in its "off" or open state, R5 connects to the battery through R4.

#### Flip-Flop

The circuit made up of Q1, Q2 and most of the parts around them may look familiar. They make up a free running multivibrator, sometimes called a flipflop. Either Q1 turns on and connects R2 to battery minus, or Q2 turns on and connects R4 to battery minus. With R4 and R5 connected to battery minus, Q3 has no base current. That keeps the LED off.

When Q1 turns on, that forces Q2 to let virtually all of the current from R4 flow into R5, which turns on Q3 and the LED. The two transistors turn on and off at a rate determined mostly by the size of the base resistors and the cross-coupling capacitors, C1 and C2. Battery voltage and circuit loading will also affect the speed.

#### Options

By adding SW3 to the base circuit of Q2, we can force Q2 to stay turned off. That keeps the flip-flop from running. That also turns on Q3 and the LED Again, by adding SW2 and the photocell to the base of Q3, we have automatic light control. Even if the photocell turns off the light, the rest of the circuit draws only a small amount of current: 300uA (300 microamps) with a 4-1/2 volt power supply. That figure came from a direct measurement on the workbench.

#### рното н

Reading Light Adjustable light level, Adjustable beam placement Hang it on a tent line or clip it to your shirt for hands-free reading. You can even clip it to a book. Due to the regulator circuit, the light level will remain relatively constant despite wide variations in battery voltage. This one will operate from five to 45 volts.

Let me mention here that unless otherwise stated, what I write is based on WORKING models. Some of them have sat on the workbench running for many days and nights uninterrupted. If I make a wet-finger-in-the-wind approximation, I will make it clear that I am giving just a good guess. Normally, all of my circuits get thorough tests before I write about them. We have all seen circuits that worked one time, but not the next time. Since I know that that can happen, I try to make it less likely that you will have unexpected, undesired, surprise results.

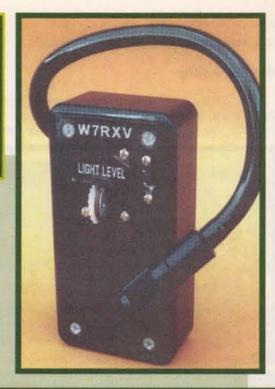
#### Biking, Hiking

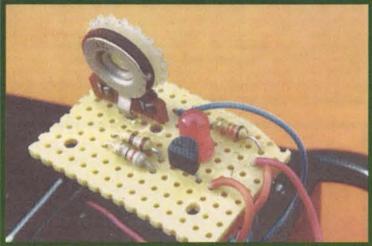
For those who like to hike or bike, we can make a few additions and have a useful, practical, addition to our equipment. You can change the values shown in the circuit of Figure 2. By using capacitors with different values, you can make the LED flicker on, flicker off, or have uniform on/off times. The suggested values give uniform on/of times. The smaller capacitors give a rapid-fire effect.

Package that circuit so that you can clip it to your backpack, and friends will find it easier to follow you when hiking in dimly lit areas. If several in your camping/hiking group wear one of these beacons, you will find it easier to keep track of each other. Use either white LEDs or the jumbo yellow LEDs, and package it in a housing with a yellow lens and you have good light for the front of your bike. One that lets others see you. Of course, you still need a good, bright headlight that will let you see the road.

#### **Back Light**

Use a pair of extra bright red or yellow LEDs in the light, as in Figure 3 and Photo G, and you have an out-





#### PHOTO I

Adjustable-Light Circuit Board Upper left: trim pot used to adjust the light. Next to that, LED used as voltage reference. Upper right: base bias resistor. Center left: fixed resistor with trim resistor, not shown in circuit. Front right: the single transistor used for the regulator circuit. This circuit, like that of Photos C and D, and Figure 1B, uses so few parts that it seems that there is no need for a printed circuit board. Front left and right: two of the mounting holes. The next version will have the trim pot replaced with a two-position (ON/OFF) switch and fixed resistors for High/Low Light level. A small rotary switch with fixed resistors would give High, Medium, and Low.

# **USB** Relay Module

#### Model JSB-210

Controls 8 to 16 "form C" relays over the USB (Universal Serial Bus). Program the module with simple commands in any program language that supports USB Communications. Driver and sample code provided

#### J-Works, Inc

12328 Gladstone St., Unit 4 Sylmar, CA 91342 (818) 361-0787 Voice (818) 270-2413 Fax

#### Other Products

RS-485 Remote I/O ISA Waveform Generator RS-485 to DS-1820 RS-485 Temperature I/O DS-1820 Probe

Visit our Web site for Information on all our products http://www.j-works.com E-mail sales@ j-works.com

# Your shrinking options are expanding

NEW!

# MicroCore-11

tiny 2" x 2" 68HC11 module

RS232, 5V regulator, 8MHz crystal

32K SRAM plus 8K or 32K EEPROM

 plugs into your breadboard like a DIP 8K Starter Package #MC11SP8K......\$75\*

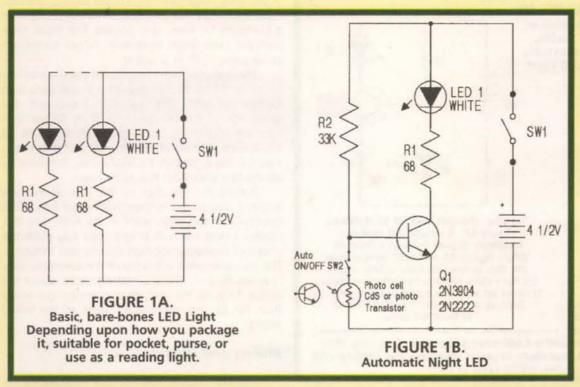
32K Starter Package #MC11SP32K...\$89\* \* plus shipping & handling Visa•MasterCard•Discover•Amex

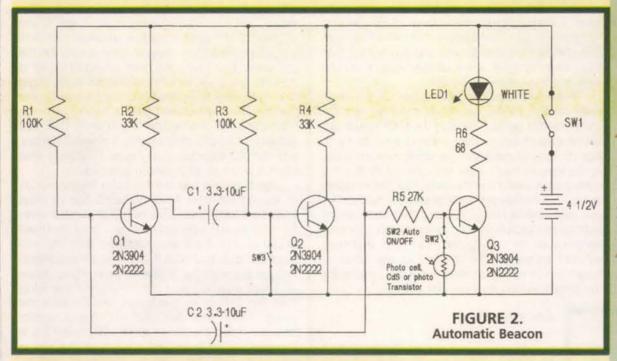
Phone: (416) 963-8996

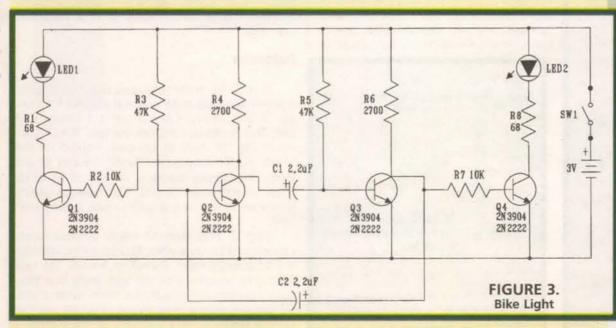


Fax: (416) 963-9179

www.technologicalarts.com







For an exceptionally bright back light, use high brightness red or orange LEDs. For an even brighter light for the front of the bike, use one or two of the white LEDs and a yellow lens. Just raise the battery to three cells, 4-1/2 volts to take care of the extra voltage drop in the white LEDs. The rest of the values may stay as they are drawn. These compact, attention-getting blinkers work well for use on the trail when biking or hiking.

For the ultimate in a small, long life light, Figure 1A. For a little more effort, an automatic night LED, Figure 1B. Figure 1A can take many forms, limited mostly by your imagination. Figure 1B needs a slightly larger holder, but it has more uses. The values shown will give about 13mA LED current. A 39-ohm resistor will give close to 23mA. That is close to the 25mA maximum LED current. It will make a bright light. As indicated by the dashed lines, you may add more LEDs to any of these circuits. Just use a separate resistor for each LED. With "N" cells and 13mA total drain, expect about 60 hours operating time. At 25mA, expect 32 hours.

standing back light for your bike. These lights use the jumbo, 10mm, extra bright LEDs. They have cut the price, made them easier to get, and made them many times brighter than the early 'extra bright' LEDs. While you can use the white LEDs for these applications, unless you can get them at a good price, the red or yellow LEDs give plenty of light and attract a lot of attention. And you thought that we were just going to make a flashlight.

#### More Than Just a Flashlight

The white LEDs give a lot of useful, visible light. While some of the red, orange, and yellow LEDs carry a high MCD rating, the eye responds differently to different colors. The eye will perceive some lights as brighter than others even though they may have the same MCD rating. Most of the people that have seen the white LED lights say that they look brighter than the red or the yellow LEDs. That puts more than "... beauty in the eye of the beholder."

Changing the values of C1, C2, or both, will give a variety of interesting and useful effects. You can make the LED flicker on, flicker off, or give uniform on/off times. The suggested values give uniform on/off times. The smaller caps give a rapid-fire effect. For use with a 6V battery, make R1 150 ohms; with 9V, 390 ohms. For use with the other types of LEDs, use a 3V battery.

Regardless of what a light meter indicates, how the eye sees the light is what counts.

#### Reading Light for Campers and Others

A large flashlight cannot compete with a twomantle gaslight. Of course, an LED light does not begin to compete with that, at least until they make great improvements in the LEDs. You could always put several white LEDs into a single light. If it does not drain your budget, it would not drain the batteries. It will put out a lot of light.

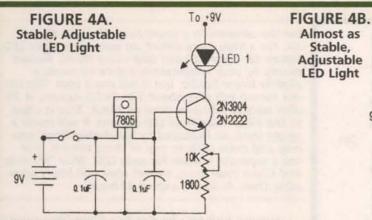
One of my camping friends has a reading light made for camping. It clips onto the side of a book. He replaced the Tungsten light bulb with one of the white LEDs. The original light drew 0.3A at about 6V. It gave many nights worth of reading. When I got to it, the batteries measured just over five volts, meaning that they had seen a fair amount of use.

We calculated the proper value for the current limit resistor and put in the LED. (Basic circuit of Figure 1A.) He turned the lamp on and took it home. It still had the used batteries in it. The light ran for more than eight weeks day and night. He said that it compared favorably with the original light. It just did not light up as much of the room. A little more arithmetic indicated that he could shrink the package, which uses four "C" cells. That would allow the use of smaller batteries and still give

several weeks of normal use when camping

#### What Size Resistor?

The camping light just mentioned came with



With the resistors set for higher current as indicated in the caption below, this could make a good reading light. The light would not fade when the batteries do, as it does with the simpler battery, resistor LED circuits such as Figure 1.

The values shown will give an LED current of ~0.36-2mA. The battery voltage may range from 8-30 volts. This might be a good way to light the keyboard on a laptop computer in an otherwise relatively dark place.

For more light, change the resistors to 180 ohm fixed and a 1,000 ohm adjustable. In a test, that gave 3-22mA. If you want to use more than one LED, put them in series and raise the battery voltage. It took just over 12 volts to get this to work with two white LEDs in series.

Almost as

Stable.

**LED Light** 

97

four batteries. It was easier to adjust the size of the current limit resistor to accommodate four batteries. than it would have been to repackage the lamp with just three batteries. To get the value of the resistor, subtract the voltage across the LED from the battery voltage. Then divide by the current that you want in the LED. For example, 6V battery minus the 3.6V in the LED equals 2.4V. Divide that by the current 15-20mA, 25mA if you are braver than I am, and you get 160-120 ohms.

For the maximum current the manufacturer allows, 25mA, use 96 ohms. Six volts (battery) minus 3.6 volts (across the LED) equals 2.4 volts (2.4V/0.015A=160 ohms). The nearest standard values are 150 for the 160-ohm resistor, 120 for the 120, and 100 for the 96. You can get a 91-ohm resistor, but that would allow a calculated value of 26+ mA

I do not like to push the ratings of these types of semiconductors. If you use real fresh batteries and the resistor is a bit on the low side of its tolerance ... Keep in mind that a fresh "1.5V" alkaline battery measures, and delivers, 1.6V. Three of them deliver 4.8V. Do the arithmetic and you will see that three fresh batteries and a 68-ohm resistor will put close to 17 mA through the LED.

12K\$

Simpler, cheaper, almost as stable as Figure 4A. A cheap LED makes a

relatively decent voltage reference.

While Figure 4A will hold better than

1%, this circuit will hold within about

5% for ~150% change in battery voltage.

It takes up less space and will run with as

little as 4-1/2 volts. Figure 4A needs at least 6-7 volts.

If you had calculated your values for the maximum current, 25 mA, you could easily go over the limit. I cannot guess how long the LEDs would survive. I suspect longer than I would want to try it. But, do keep in mind the real world considerations as the reasons that I make the values such that the current stays away from the limits. Feel free to experiment, but remember semiconductors seldom let you exceed their ratings for long. My observations indicate that LEDs have even lower tolerance for over current than do some power transistors that have survived on my test bench. One of the tables in Figure 5 may help you select a suitable resistor for the battery voltage that you want to use.

#### Table 1 1/2 volts, 3 cells 20 25 39 LED current, mA nearest standard resistor 56 Table 2 6 volts, 4 cells 25 100 LED current, mA nearest standard resistor 120 220 150 Table 3 9 volts, 6 cells 25 220 LED current, mA 10 nearest standard resistor 560 390 270 volts, 8 cells LED current, mA 10 330 nearest standard resistor 820 560 390 14 volts, automotive 20 560 10 15 22 470 LED current, mA nearest standard resistor 1000 680

#### FIGURE 5. Tables for voltage, resistor, and LED current for white LEDs.

This should help you pick a resistor for the desired battery and current for a white LED. For a 6V lantern battery and 25mA, use a 100-ohm resistor. Do not mistake 12 volts for automotive. An automotive electrical system runs closer to 14 volts than it does to 12 volts. Do keep that in mind if you want to run one of these beacons in your car. They draw so little current that they could run many hours on a car battery without cause for concern about battery drain

#### Construction

As mentioned earlier, the models in Photos A and B do not lend themselves to home construction; unless you have a lathe at home. My next door neighbor does, I don't. He lets me watch. The light shown in

Table	6
Туре	milliamphours to about the one-volt level
76	110
9V	580
N	800
AAA	1100
AA	2800
C	7800
D	15,000
	FIGURE 6.

#### Current ratings for several popular batteries.

The values came from various manufacturers and are presented without personal verification. They may help you select the battery for your particular need. Example: With type 76 cells, 110mAH and a 15mA drain – such as the light in Photo A – expect about 6-7 hours. With a 9V battery, 580mAH hours, and a 20mA drain, expect 25-30 hours. With a 25mA load and AA batteries, you could look for around 110 hours. That is a lot of reading or looking for things in dark places

Photo C uses slide switches. I prefer toggle switches. However, toggle switches can turn on by accident in a backpack or even in a pocket. The small slide switches have fewer tendencies to get turned on or be broken off by accident.

The real small switches do not need a machinist to install them. The fact that I had early bad experiences with slide switches makes me shy away from them. Double-check them to see that they are of a good, solid construction. Some of those early slide-switches made contact only when they felt like it. Despite my inhibitions, they have to be the first choice for this application.

Putting the switches on the side of the box makes it easy to get to them with either hand. The photocell, in this case, went in the front. The box shades it from the built-in light. You may place the photocell in another location as suits your thoughts. The photocell went in the top of the automatic beacon, see Photo E. There is nothing critical about the layout. As usual, the neat, clean printed circuit board from Far Circuits makes quick work of the board

#### Milling and Drilling

LED 1

2N3904

2N2222

You may find it easiest to make the holes for the LED and the photocell first. If you make the hole for the LED just a bit small, you can make a tight fit and not have to cement it in place. A couple of pins from a machine-pin socket make a good socket for the LED wires. That keeps you from having to solder to the LED, and if you need to reverse the wires to get it to light, you have simplified that. Normally, the package shows which lead goes to battery plus. You may save a bit of time later if you verify that. Just connect a 560-680 ohm resistor, a nine-volt battery, and the LED together as in Figure 1. Make a note which lead of the LED goes to battery plus.

Next, lay out and drill the holes for the switches. Install them. Wire the circuit board. Run the wires from the board to the switches. Then run the wires from the board to the photocell and from the board to LED or LEDs if you use more than one. The transistor can drive two LEDs if you want the extra light. Just put in a separate resistor for each LED as shown in dotted lines in Figure 1A. Finally, run the wires from the battery to the board. Double-check the wiring. Make sure that each LED has a resistor between it and the power source. The board fits in between the batteries and the top of the box as seen in Photo D. If everything looks good, turn it on and start reading, or just enjoy the cool, automatic night LED

#### **Batteries**

One of the prototypes used four "AAA" cells. If someone would make available a holder for a single "AAA" battery, I would use it. I cannot find one. That leaves two choices: use two "AAA" holders or use "N" cells. In this case, I opted for the "AAA" batteries because I found it easier to get them. That meant changing the size of R1 or its equal in the other circuits. The tables suggests resistance values for use with various battery volt-

Table 3 gives nine-volt values because someone wanted to run a white LED on a nine-volt battery at a low current: 0.3mA to 3.5mA. The LED flashlights advertised on the web imply that they have a current adjust built into them. While a simple variable resistor in series with the LED and the battery would allow adjustment of the current, I made a constant-current generator. That gave this researcher an adjustable, as well as a stable light.

#### Independent LED Current

Figure 4A gives the circuit of an almost preci-

sion constant-current generator. This circuit will let you put from 8-30 volts across it. The light will remain quite stable despite the changes in battery voltage. It makes the light level virtually independent of battery voltage. That holds until the battery voltage falls too low for the regulator. No figures, as I did bother to measure it with a light

#### **Current Regulator**

The 7805 regulator in Figure 4A maintains five volts across the emitter-base junction of the transistor. That keeps close to 4.4 volts across the resistors in the emitter circuit. Divide the resistance in the emitter into the voltage, and you get the current. That is the basis for some simple, effective, practical constant current generators. Make the emitter resistors adjustable and, in this case, you have made the light level adjustable.

You also made LED current independent of the battery voltage. It will allow you to put two or more LEDs in series without adding extra resistors. The minimum battery voltage must equal the voltage drops across the LEDs, and the voltage in the regulator. Two LEDs equal 7.2V, the regulator equals five, for the 7805; that adds up to just over 12 volts. With the slightly less precision LED used as a reference (Figure 4B), you get around eight volts. These values are for two LEDs in series.

#### Simpler, Cheaper

Figure 4B gives the circuit for a simpler and

somewhat cheaper constant-current generator. The voltage drop across common LEDs runs around 1.6-1.8 volts. It varies almost enough to notice with 'normal' temperature variations. However, it gives the circuit enough stability for this application. You can put as little as five volts and as much as 35, even 45 volts across this circuit. Large changes in battery voltage will cause the light to vary more than the circuit in Figure 4A. But this circuit will allow a wider range of voltages, particularly at the low end. Photo H shows a clip-on reading light made with this circuit.

If you want it for use in a tent or other place with limited battery power, package it so that you could clip the power connections to a lantern battery. That would give a long life reading light. Table 4 gives millampere hour ratings of several common batteries.

From that, you can make a good guess as to what kind of life to expect from the batteries in your reading light or bike light. It can help you choose the type of battery and the size of the package. The slightly, rounded off figures in Table 4 came from several manufacturers. They assume a useful battery down to about the one-

The gooseneck lamp holder came from a reading-light as did the clip on the back of the box. That allows you to clip the light onto the book, to a line in your tent, or onto your shirt for hands-free reading. Feel free to E-Mail me at Evertf@asu.edu if you want more details on that or on anything else mentioned here. I do reply to all correspondence.

#### Bike Light

Some of the more common back lights for bikes use several of the small, bright LEDs. All of them turn on or off at the same time. The circuit in Figure 3 gives the details of the backpack/bike light. This one uses two LEDs that flash back and forth. That way, one light is always on, and it gets a lot more attention than the model that turns all of the lights on and off at the same time.

Photo G shows the works. The housing comes from an automotive supply store. Here, we take advantage of the optics they built into the sidelights normally found on trailers. We place the LEDs as close as practical to the focal point of the lens; about 1.9 inches center to center. That narrows the beam a bit, but projects it a lot. The plastic lens (not pictured) also diffuses the light a bit. That gives it a wider viewing angle.

You do not have to be directly in line with the light for it to get your attention. With two extra bright LEDs flashing alternately, and a lens on the unit, it makes itself quite visible. On a dark street, or one with normal lighting, it is easy to spot one of these lights two blocks away.

#### Bike or Backpack

Depending upon whether you want it for bike or backpack, you can get a housing with either a red or a yellow lens. White LEDs will work with any color lens that you want. Red LEDs cost the least, and are the most traditional. You can get an exceptionally bright orange LED, 12,000MCD. However,

**Parts Lists** 

#### Basic, Bare-bones LED Light (No Photo, Figure 1A)

#### Auto ON/OFF (Photo C, Figure 1B)

R1 39-68 ohms for 25-13mA per LED

R2 33K LED 1 SL-A05C11C1-SB; 1-800-722-6445 for local Selecta distributor

CMD333UWC 1-800-344-4539 Digi-Key; same part number for Chicago Miniature Lamps Co. Digi-Key will ship small orders (under \$25.00), some mail-order companies

SW1 ON/OFF SPST slide switch 275-406 (RadioShack)

SW2 Auto-ON/OFF SPST slide switch 275-406 (RadioShack)
Battery holder "N" 270-405; three each
BOX 270-1802, approx 4x2x1

Batteries "N" three each Q1 2N3904 276-1617 (pkg. of 15) NPN transistor

Photo Cell CdS or Phototransistor 276-1657 or 276-145

#### Automatic Night LED (Photo E, Figure 2)

100K

33K R3 100K

R4 33K

R6 39-68 ohms for 25-13mA LED current
C1, C2 3.3-10uF, 272-1024, 4.7uF smallest RS lists; 272-1025, 10uF
Q1-3 2N3904 276-1617 (pkg. of 15) NPN transistor
LED 1 SL-A05C11C1-SB; 1-800-722-6445 for local Selecta distributor
CMD33UWC 1-800-344-4539 Digi-Key; same part number for Chicago Miniature
Lamps Co. Digi-Key will ship small orders (under \$25.00), some mail-order companies

Photo Cell CdS or Phototransistor 276-1657 or 276-145 SW1 ON/OFF SPST slide switch 275-406 (RadioShack) Pkg. Of 2. Two packages would give you an extra switch.

SW2 Auto-ON/OFF SPST slide switch 275-406 (RadioShack)
SW3 Blink ON/OFF SPST slide switch 275-406 (RadioShack)
Battery holder "N" 270-405; three each
BOX 270-1802, approx. 4x2x1
Batteries "N" three each

Perf board or Circuit board Far Circuits, 18N640 Field Court, Dundee, IL 60118

R1 39-68 ohms for 25-13mA per LED
LED 1 SL-A05C11C1-SB; 1-800-722-6445 for local Selecta distributor
CMD333UWC 1-800-344-4539 Digi-Key; same part number for Chicago Miniature
Lamps Co. Digi-Key will ship small orders (under \$25.00), some mail-order companies

SW1 ON/OFF SPST slide switch 275-406 (RadioShack)
Battery holder "N" 270-405; three each
BOX 270-1802, approx. 4x2x1

# Bike Light (Photo G, Figure 3)

68 ohms

33K-47K; 33K probably best if you can not get 2.2uF caps and have to use 4.7uF.

27K may give an even better flash rate with the 4.7uF cap.

R5 33K-47K; 33K probably best if you can not get 2.2uF caps and have to use 4.7uF 27K may give an even better flash rate with the 4.7uF cap.

R7 10K

68 ohms

C1, C2 3.3-10uF, 272-1024, 4.7uF smallest RS lists; 272-1025, 10uF

SPST slide switch 275-406 (RadioShack) 276-206 SW1 ON/OFF

LEDS Orange

276-086 Battery holder 270-408 (enclosed 2-"AA" holder) Batteries "AA" two each

Housing Auto supply clearance marker light; Peterson, PM V138R for red or 138A for yellow. Of course, if you cannot find one of these, you may build it in some other housing. These housings have a lens that focuses the light.

Circuit Board Far Circuits, 18N640 Field Court, Dundee, IL 60118

#### Adjustable Reading Light (Photo H. Figure 4A, 4B)

Figure 4B Photo I Figure 4A

7805 0.1uF, two each 10K trim pot 1800 ohms 2N3904 1K trim pot Cheap LED 2N3904 2N2222 2N2222

SL-A05C11C1-SB; 1-800-722-6445 for local Selecta distributor CMD333UWC 1-800-344-4539 Digi-Key; same part number for Chicago Miniature Lamps Co. Digi-Key will ship small orders (under \$25.00), some mail-order companies will not

At this time, you can find the white LEDs only at the two places listed. As they become more popular, you should find it easier to get them. The parts list gives the information needed to make the basic, bare-bones LED light, Figure 1A. Photos A and B show machinist versions. No photo for the practical version. Of course, it could go in a slightly smaller package than the Automatic Night LED seen in Photo C

the eye may be more sensitive to the cheaper yellow LED. It carries a 6,000MCD rating. Either of these works well with a yellow lens. I have done both. My son gave his stamp of approval as he put one on his bike and the other one on his wife's bike and said thanks as they rode off.

#### Assembly

Once you decide which housing you want, you may pry the lens off of the clearance light with a flat-bladed screwdriver. Next, remove the 12-volt lamps and their sockets.

Save them for other projects. Install the resis-

tors, transistors, capacitors, and your choice of LEDs in the boards. Note carefully the polarity of the LEDs. Run wires from the board to the switch, then the wires from the battery holders to the

As usual, I used toggle switches in my bike lights. If you can find waterproof switches and want to water-proof the housing, do it. Here in Phoenix we do not have to, or even get to ride in the rain that often.

#### **Check Out Time**

When you finish the wiring, as always, check

the placement of the capacitors and the LEDs. When that looks good, apply power. Remember that the red, orange, and yellow LEDs use a threevolt, two-cell battery pack. A pair of "AA" penlight batteries gives reasonably long life; an estimated 120 hours.

By using the circuit in Figure 3 - separate flipflop with LED drivers - the circuit will keep on ticking even when the battery voltage falls to less than two volts. It will get dimmer, of course, but it will still tick tock

The textbooks tell you that an ordinary dry cell has run down when it falls to about 80% of its new voltage. That figures out as 1.2 volts for a 1.5-volt

> battery. Even at 2.4 volts, these lights still make themselves quite vis-

#### **Cheaper Circuit**

You could change the values of R3-6, as well as the size of the capacitors, and eliminate the driver transistors. At the same time, you could get rid of R2 and R7. That would save a few parts. I tried it on the workbench.

When the power supply voltage dropped too low, both LEDs just turned on and gave a dim, steady glow. Since that did not save enough parts or space for the less desirable results, I did not make a drawing.

#### What Color LEDs?

You can use the white LEDs in this dual, flashing light, but you will have to increase the battery voltage by one battery: 1.5 volts. That will get you over the threshold voltage for the white LEDs. The 68-ohm resistor will work. That will give about 13mA lamp current.

You may want to increase that by using a 47-ohm resistor for R1 and R8. That will give about 19mA and still have reasonable battery

Since you have some room and want long battery life, "AA" cells seem like a good choice.

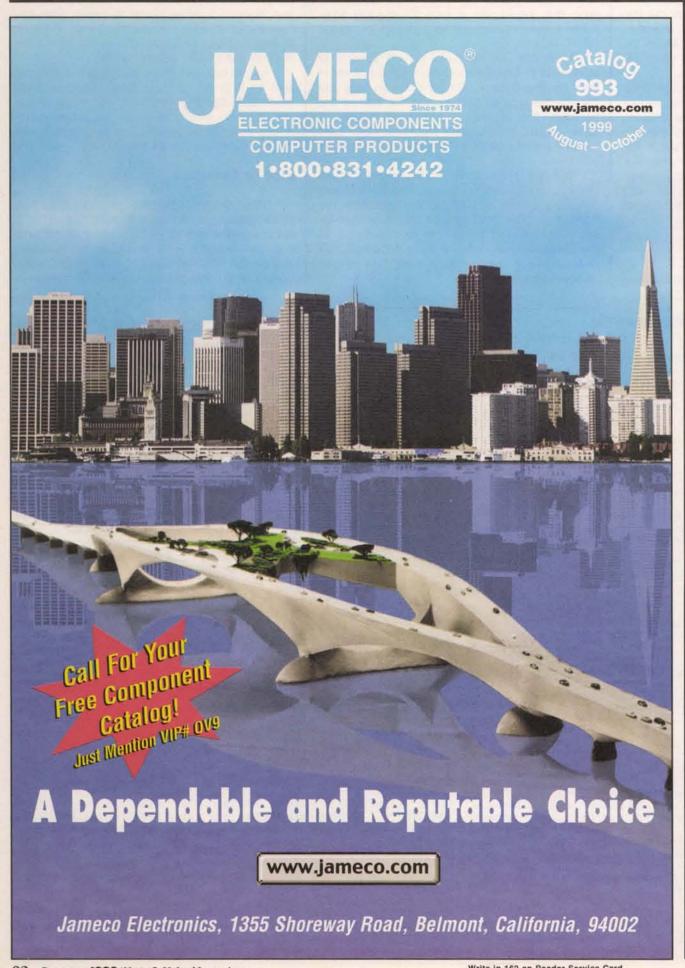
You can get a single "AA" holder. That lets you use just 4-1/2 volts for the battery supply. That will let you use either the more useful white LEDs or the easier to get red, orange, or yellow LEDs.

#### You Pick It

Select the type of LEDs, the package, the options, and the battery voltage that gives you the camping, biking, reading, or flash light best suited to your activities. That may include hiking, biking, or reading a book after "lights out."

These LEDs give an astounding amount of light for such a surprisingly small amount of current. That makes these applications of these lights especially practical. You can probably think of additional applications.

We hope that whether you use the automatic night LED or one of the other circuits, it will make your camping, hiking, biking, or late night reading a bit more enjoyable. NV



# New Product News



#### **NEW 17TH EDITION** "ROBOT STORE" CATALOG

ondo-tronics' Robot Store unveils the world's biggest collection of hobby robot kits, books, and parts in its free catalog.

The catalog features the newest Lego® MindStorms™ sets, including the new Star Wars® Droid™ Developer Kit and the Robotics

Discovery Set™.

Another recent addition is the Cye™ robot, a fully-assembled, programmable platform for advanced household functions. Wagon and vacuum attachments, sold separately, let you put the Cye robot to work cleaning house and fetching refreshments. Cye opens new realms for practical home and office robotics using just a common desktop PC.

The Picza 3-D scanner and Modela 3-D fabricator bring a new frontier of creative technology to hobbyists of all ages.

The simple, inexpensive Picza digitizing scanner uses a thin piezo feeler to sample scan an object and build a map of its surface

The Modela fabricator drives a 4500 RPM cutter to carve objects from a wide range of materials, including jeweler's wax, modeler's foam, balsa wood, even plaster of Paris. Finished models can be used directly, or as masters for casting in other materials.

The catalog offers a combo pack which includes both scanner and fabricator, plus TrueSpace 3D software, a modeling and animation tool which helps you design your own custom robots, parts and systems, then bring them to life on your computer before you build them.

#### LATEST LEGO® MINDSTORMS™ **ROBOT KITS**

Robot Store features MindStorms™ Robot Kits. latest Lego®

The Star Wars® Droid™ Developer Kit lets budding robot designers combine the power of the force with their imaginations to create classic droids from the Star Wars movies. Starting at the first level, Jedi apprentices can build and program R2-D2 and L-3GO droids using step-by-step building instructions and guided help from the CD-ROM, then using the building tips to construct even more complex droids.

At Jedi Master status, the force guides in the creations. Partial building instructions for master level droids like a battle droid and a Gungan sub get you started, but then you're on your own. Let the force be with you!

The kit includes the Micro Scout, the smallest Lego microcomputer with a built-in light sensor, motor, and seven built-in programs. Each droid can be built separately using the

The MindStorms Robotics Discovery Set provides everything needed to bring Lego creations to life, using the included Scout microcomputer, which lets you create over 3,000 different behaviors with the touch of a button.

The constructapedia manual gives step-bystep guidance in building three different robot provides and the second of the second of

creatures: The Bug, Intruder Alarm, and the Hoop-o-bot. After you master these bots, take the challenges from the constructapedia and build the Radar Runner, the PhotoBot, and many more!
For more information, contact:

**MONDO-TRONICS** 4286 REDWOOD HWY. PMB-N, DEPT. NV SAN RAFAEL, CA 94903 5-491-4600 FAX: 415-491-4696 E-MAIL: info@mondo.com WEB: www.RobotStore.com



#### **WIRELESS SURVEILLANCE SYSTEM AS-1004**

atco's AS-1004 wireless surveillance system combines state-of-the-art performance with an easy wireless setup.

The AS-1004 operates on an FCC approved 2.4 GHz frequency for sharp, interference-free images and sounds. Its 300-foot range in a home-office setting is much higher if an optional patch antenna is used.

This system has audio capabilities and can be expanded to monitor up to four cameras simultaneously; with channels being either held or skipped. If more than four locations must be monitored, but not simultaneously, unused cameras can be switched on or off as needed. For example, if eight cameras are used, four cameras can be used during the day, and a different four cameras can be monitored at night. So by juggling cameras, a wider coverage area can be handled.

Each camera operates on its own separate noise-free FM channel, has a built-in 3.6mm wide angle lens with a high 400 TV lines of resolution.

System prices start at \$169.00, which includes a transmitter, receiver, camera, power adapters, complete mounting hardware, and color coded video and audio plugs, for monitor or VCR hook-up. Additional cameras may be purchased.

For more information, contact:

MATCO, INC. 830 E. HIGGINS RD., STE. 111G, DEPT. NV SCHAUMBURG, IL 60173 1-800-719-9605 FAX: 847-619-0852 E-MAIL: MatcoCam@aol.com WEB: http://www.mat-co.com

Showcase your New Products here! Send all press releases or information/photos to:

**Nuts & Volts** Magazine New Product News 430 Princeland Court, Corona, CA 91719 or E-Mail to newproducts@nutsvolts.com



#### **NEW DIP ADAPTER MODULES**

ccutek Microcircuit Corporation introduces a new series of adapter modules that eliminate the need to

redesign costly motherboards.

Accutek DIP adapter modules feature 8 to 32 pins for converting an IC that is packaged in a surface mount SOJ, TSOP, PLCC, or SOIC package to pin compatible direct drop-in replacement for end-of-life DIP ICs. Developed for users with motherboard designs that require DIPs now obsoleted by manufacturers, they include an on-board decoupling capacitor.

Measuring from 0.400" to 1.600" long, depending upon the number of pins, Accutek DIP adapter modules can incorporate 0.300" to 0.600" row-to-row spacing with 0.100" lead spacing.

Custom configurations up to 200 pins and

multi-chip and double-sided modules are also

Applications include VME, DSP, video, COTS, medical instruments, and industrial computers.

Accutek DIP adapter modules are priced according to configuration, are fully tested and include a lifetime limited warranty.

For more information, contact:

ACCUTEK MICROCIRCUIT CORP. 2 NEW PASTURE RD., STE. 1, DEPT. NV NEWBURYPORT, MA 01950-4054 1-800-652-7505 or 978-465-6200 E-MAIL: accutek@seacoast.com WEB: http://www.accutekmicro.com

#### Fantastic DMM Offer!

Don't let this price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equippe with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/ RANGE selector rotary switch. Rubber

Boot Included! Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity errange Indication: 3 Least Significant Digits Blan nperature for Guaranteed Accuracy: 23°C

±5°C RH<75%

±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery
(NEDA 1604)
Low Battery Indication: BAT on Left of LCD Displ:
Dimensions: 188mm(L) × 87mm(W) × 33mm thick
Net Weight: 400g Gel All the Specs From O

#9300G

#### 2GHz RF Field Strength Analyzer Protek requency Range: 100KHz to .060MHz

2,060MHz
Narrow Band FM (NFM), Wide
Band FM (WFM), AM and Singl
Side Band (SSB) Modulated
Signals May Be Measured
PLL Tuning System for Precise
Frequency Measurement and

Tuning

LED Backlight LCD (192x192

dots)

Built-In Frequency Counter
Hand-Held and Battery

www.web-tronics.com

 Hand-Held and Battery
Operated
 All Functions are Menu Selected
 RS232C for PC Interface and
 Printer
 See the web site for details #3201

#### Removable Hard Drive Rack For IDE/Ultra DMA Hard Drives

We Sold Over 14,000 in 1998!

This product can be used with any 3-1/2 IDE

\$1495

18°

any qty.

This product can be used with any 3-1/2 IDE hard drive up to 1" high. It includes an electronic keylock for safe removal and insertion. Made of ABS 707 fireproof plastic. Use this product to protect sensitive hard drive data, take your hard drive between work and home or even set up different users with their own hard drives that they physically insert every time they use a PC. Other models available from C.S.I. include RH10 series and RH20 series, which are interested accient (IDE or SCSI).

other Models are Available. See www.web-fronics.com under "hard drive and accessories" for more details and pictures.

#### Removable Hard Drive Rack with Auto Door And Cooling Fan Auto Door And Cooling Fan

Auto door on the outer frame ABS material of outer frame, High

efficiency cooling fan Worldwide patent pulling function

handle CE Approved

Coating iron bottom cover For IDE interface

**#MR-27** 

Pinhole lens

\$129.00

any qty.

with audio

VM3010PA

33mmx33mmx18mm

I STREET, STRE

Details at www.web-tronics.com

For 1" high 3.5" HDD
Not compatible with our RH10 & RH20 series. Compatible with our RH17-IDE model.

Details at www.web-

UN

#### Auto-Temp Solder Station with Ceramic Element

Heating Element for More Accurate Temp Adjustment 3 Conductor Grounded Po

Cord 250°C-480°C (470°F-900°F) Fast Heating Feature

SR-976 Extra Tip Options Available, See Web!

For More Info See www.web-tronics.com

#### **CCD B&W Board Cameras**

- ASIC CCD Area Image Sensor Extremely Low Power Consumption 0.5 Lux Min Illumination
- **Built-In Electronic Auto Iris for Auto**
- **Light Compensation**

Detailed Specs on the Web



#### VM1030PA-B

30mmx30mmx25mm Pinhole lens with audio, I2V

49.00 any qty.



Easy to Navigate Includes a Search Engine

CTRL - D

any qty

VM1035A 42mmx42mmx25mm

Standard lens with audio, I2V with back

light compensation \$59.00 any qty



In Business

# \$49.00 any qty

Circuit

Speciali

VM1036A 32mmx32mmx25mm Standard lens with audio, 12V, reverse mirror mage feature

\$59.00 any qty

#### COLOR CCD Mini **Board Cameras**

- Low Power Consumption
  1 Lux Illumination
  Built-in Electronic Auto Iris
  for Auto Light Compensation
  Internal Synchronization
- 12Volts

400 TV Lines



VM3010-A 33mmx33mmx32mm

Standard lens with audio \$129.00 any qty.

Detailed Specs on the Web

Amazing Oscilloscope Offers

#### **Bullet CCD Cameras**

- **B&W** and Color Smart Rugged Metal
- Extrememly Low Power Consumption 12 Volt Housing

12 Volt
CCD Area Image Sensor
for Long Camera Life
Built-In Electronic Auto Iris for Auto
Light Compensation
No Blooming, No Burning
0.1 Min Lux Illumination (B&W), 1 Lux
Min Lux Illumination (color)



VMBLT1020A B&W with audio 21mm(D)x55mm(L) \$69.00 any qty

Detailed Specs on

#### Protek

Series 6500 Deluxe 20MHz/40MHz/60MHz/100MHz **Dual-Trace Oscilloscopes** 

Alternate Trigger

#6502 - 20MHz

Internal Sync Seperator Circuit

Alt-Mag Sweep Delay Sweep (6510)

DESIGNS!

LATEST prices while they last! #6504 - 40MHz #6510 - 100MHz

#6506 - 60MHz

\$689

12KV

Asia's currencies are

devalued against U.S. dollars.

Take advantage of GREAT



# new! Mini CCDs (B/W & Color)

VMBLT3025W Digital Color, Weath

Digital Color, Weatherpro-20mm(D)x83mm(L)

189,00 any qty

#### Sensational NEW Design for Small Observation Cameras. Smaller and Better!

- Ultra Miniature Design Black & White Versions Only 25mm x
- 25mm Color Versions Only 32mm x 32mm Available in Standard Lens or Pinhole
- All Include Audio All Include Pre-Wired Cable Harness for Audio, Video & Power 12V Regulated Power Supply Required
- (120mA typical power consumption 0.1 LUX Rating (B/W), 1 LUX (color)
- CCD Area Image Sensor for Long a Life
- Back Light Compensation Circuit Built-In Electronic Auto Iris Lens
- VMPS-718A



25mmx25mmx30mm, B/W CCD with standard lens, pre-wired cabling for video/audio, 12V DC **Power Input** 

Detailed Specs on the Web

# VMCW-H11A

32mmx32mmx30mm, Color CCD with standard lens, pre-wired cabling for video audio, 12V DC Power 149.00 \$139



VMCW-H12A 32mmx32mmx19mm, Color CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC Power Input 49.00 \$139.0

5 or more VMPS-250A 25mmx25mmx15mm, B/W CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC



# These deluxe HC Protek oscilloscopes provide the features and accuracy that serious technicians and engineers need at prices well below what you may have expected. These dual-trace, dual-channel, scopes have Alt-Mag sweeps and provide simultaneous display of normal and magnified traces. An internal sync seperator circuit provides stable triggering of video signals. TV-H (TV line synchronizing feature) and TV-V (TV frame synchronizing frequency) are automatically switched by the Time/Div front-panel control. The user can view parallax-free waveform measurements on the large 6" rectangular CRT that includes an illuminated internal 8x10 Div graticule.

Vert. Sensitivity Max Sweep Rate

Part No. Bandwidth

Delay Sweep Vert. Mode Trig. Cursor Readout CRT Volts

6510 6506 6504 100MHz 60MHz 40MHz 1mV/DIV to 5V/Div 1mV/Div to 5V/Div 1mV/Div to 5V/Div 2nS/Div 0.1uS/Div 0.1uS/Div to 0.2S/Div to 0 25/Div to 0 2S/Div ALT-MAG YES NO 10KV ALT-MAG

strate stra

800-528-1417/480-464-2485/FAX: 480-464-5824

#### 3000 Series Digital R/O Bench Power Supplies

**♦Low Cost Single Output** ♦ High Performance Triple Output

High stability digital read-out bench power supplies featuring constant voltage and current outputs. Short-circuit protection and current limiting protection is provided. The dual output versions can be used in both serial voltage and parallel current configurations to double maximum outputs. Highly accurate LED accuracy and stable line regulation make the 3000 series the perfect choice for

lab and educational use.

Line Regulation: 2x104+1ma LED Accuracy: Voltage ±1% +2 digits Current ±1.5% +2 digits Wave Line Noise: ≤I mvrms

Dimensions: 291mm x 158mm x 136mm (CSI3003 & CSI3010) 365mm x 265mm x 164mm (CSI3003-3 & 3005-53)

CSI3003: 0-30v/0-3amp Digital R/O Bench PS, 1x104+5mv Load Regulation CSI3010: 0-30v/0-10amp Digital R/O Bench PS, 1x10<sup>-4</sup>+30mv Load Regulation CSI3003-3: Triple Output 2x(0-30v/0-3amp)+5v, 3amp Fixed, 1x10-4+5mv Load Regulation

CSI3005-3: Triple Output, 2x(0-30v/0-5amp) +5v, 3amp Fixed, 1x10-4+25mv Load Regulation

\$99.00 5/\$89.00 \$149.00 5/\$139.00 \$239.00 5/\$219.00

\$269.00 5/\$249.00

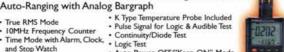
3000 Series Supplies Will Become Available Approximately September 15, 1999. Orders Are Being Taken Now.

Our Most Sophisticated DMM We Sold Over 700 Last Year! with RS-232 Interface & Software, 3-3/4 Digit, 4000 Count, Auto-Ranging with Analog Bargraph

5 or more

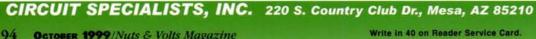
- 10MHz Frequency Counter
   Time Mode with Alarm, Clock,
- Dual Display
   10 Location Men Min, Max, Avg and Relative
  Mode
- Decibel Measurement Cap and Ind. Measu
   Temperature Mode erature Mode (C/F)





- Auto Power OFF/"Keep ON" Mode Fused 20A Input with Warning Beeper Back Light
- Safety Design UL1244 & VDE-0411
   Protective Holster
   Silicon Test Leads







6502

20MHz

1mV/Div to 5V/Div

0.2uS/Div

ALT-MAG YES NO 2KV

COPIES EVERYTHING
PARTITIONS, 0/S,
THE WORKS!

SUPPORTS ALL INTERFACES
SCS., E-IDE, 2.5", SCA

BUILT-IN DATA
RECOVERY SYSTEM

ELIMINATES DEFECTS
ON SCSI AND IDE DRIVES

PARALLEL PORT PRINTS TEST RESULTS

INSTANTLY CLONES ANY SCSI OR IDE DRIVE

# CLONE, TEST OR REPAIR ANY HARD DRIVE

"THE MOST COMPLETE HARD DRIVE WORKSTATION WE'VE SEEN!" BOB ROSENBLOOM, DIGITAL VIDEO, INC.

#### **DRIVE SERVICE STATION**

Copy entire hard drives with ease. Drive duplicators are essential tools for dealers and system builders. Don't spend hours installing and formatting drives. Do it instantly with the Pro. Set up any SCSI or IDE drive with your original software. Connect blank drives to the Pro and presss start. You'll copy entire drives faster and more accurately than is possible on any PC. With our combination IDE and SCSI model, you can even copy data between diffferent interfaces. All models include both 2.5" and 3.5" interface adapters. The Pro also supports SCA and Wide SCSI drives.

Choose the Pro, and you'll also have an entire factory drive test and repair system for under \$1000. The Pro gives 408 330-5525

you the ability to copy, reformat, repair, translate, and test any hard drive. Use the Pro to put any hard drive through its paces. A full factory final test and performance analysis is performed. Complete test and repair reports are sent to any standard printer.

The Pro will also reassign and eliminate drive defects. Here's how it works: First, a precise media analysis system scans the disk for errors. Defects are mapped out, and effectively "erased." The error correcting system then "trains" the drive to permanently avoid defective areas. Data is stored only on the safe

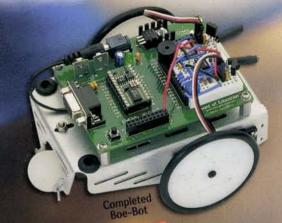
areas of the disk. Capacity is reduced by an insignificant amount, and the drive works flawlessly once again. Get the technology used by major repair shops and data recovery centers. The Pro repairs all disk defects caused by normal wear. Drives with mechanical damage may not be repairable.



#### **CORPORATE SYSTEMS CENTER**

3310 WOODWARD AVE., SANTA CLARA, CA 95054
WWW.DRIVEDUPLICATORS.COM

Call today for high volume multi-drive copiers and CD Duplicators Sold and intended for backup purposes only. Copyright laws must be observed.



# **Introducing the Boe-Bot:** Mobilize Your BASIC Stamp® and Board of Education

The Boe-Bot is a BASIC Stamp II and Board of Education (BoE) mounted on a rolling aluminum chassis. The BoE's breadboard is used for your robotic projects. The kit requires about one hour to build using a small screwdriver, box-end wrench and diagonal cutters. The Boe-Bot was created for our Stamps in Class program (http://www.stampsinclass.com). The 70-page Robotics text is loaded with projects ranging from basic movement to object detection and light following.

The Boe-Bot Full Kit includes the robot shown to the left and all the electronic components needed for roaming, object detection / avoidance with infrared, and light following. LEDs and piezospeaker provide light and sound feedback. With some advanced programming and a few components the Boe-Bot could follow a line, solve a maze, or extinguish a small fire. PBASIC is an I/O-oriented language with a command set that makes it easy to interface the BASIC Stamp to other components. The Boe-Bot was created as part of our Stamps in Class (http://www.stampsin-

class.com) program and has a complete 70page educational text.

**BASIC Stamp Boe-Bot Full Kit** #28132 - \$199 Boe-Bot, Board of Education, BASIC Stamp II, BASIC Stamp Manual Version

1.9, Robotics Text and components

**Robotics Parts Kit** 

# ROBOT Robotics text

### Education. **Robotics Text**

#28124 - \$99 Order this kit if you already have a BASIC Stamp II module and a Board of

Free download from our http://www.stamps printed version #28126 - 5

To order call Parallax toll-free 888.512.1024 8 a.m. to 5 p.m. PST

lore info? Visit us online www.parallaxinc.com or www.stampsinclass.com





# **GrowBot Upgrade:**

Mount Your PCB on the Boe-Bot's Metal Chassis for Improved Performance!

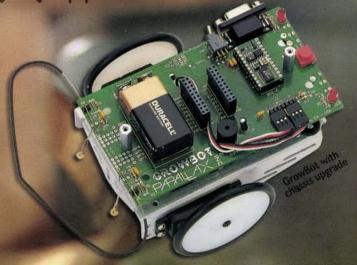
The Boe-Bot chassis was designed to accommodate the GrowBot's printed circuit board. If you've already got a GrowBot and you want to mount it on the metal chassis, order the GrowBot Upgrade Kit. The chassis will hold the servos squarely in position and provide a solid base for any additional con-struction you do on top of the GrowBot. Plug the optional AppMod onto your GrowBot and then you can build the Robotics projects using the BASIC Stamp's leftover I/O pins.

#### **GrowBot Upgrade Kit**

#29101 - \$49 Includes chassis, screws, standoffs, tail wheel, and battery pack, you'll reuse the GrowBot's PCB, servos and wheels.

#### **Bread Board AppMod**

#29114 - \$29 AppMod: Module brings BASIC Stamp I/O pins, Vss, and Vdd connections to the perimeter of breadboard.



Write in 194 on Reader Service Card.

**NUTS & VOLTS MAGAZINE 430 PRINCELAND COURT** CORONA, CA 92879-1300